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ABSTRACT

This document is designed to provide practical information for teaching the Science 20-30 Program of Studies. The first section provides an overview of Science 20, explaining the program philosophy as well as clearly demonstrating how the program articulates with the junior and senior high science courses. The use of concept connections and teaching a course around locally developed themes is described. Section two contains four units. Unit one, "The Changing Earth," emphasizes change and diversity. Unit two, "Changes in Living Systems," emphasizes the themes change, energy, matter, and systems. Unit three, "Chemical Changes," emphasizes change, energy, and matter. Unit four, "Changes in Motion," emphasizes change and motion. The final section provides detailed information on a great variety of resources that support the implementation of this program. (ZWH)

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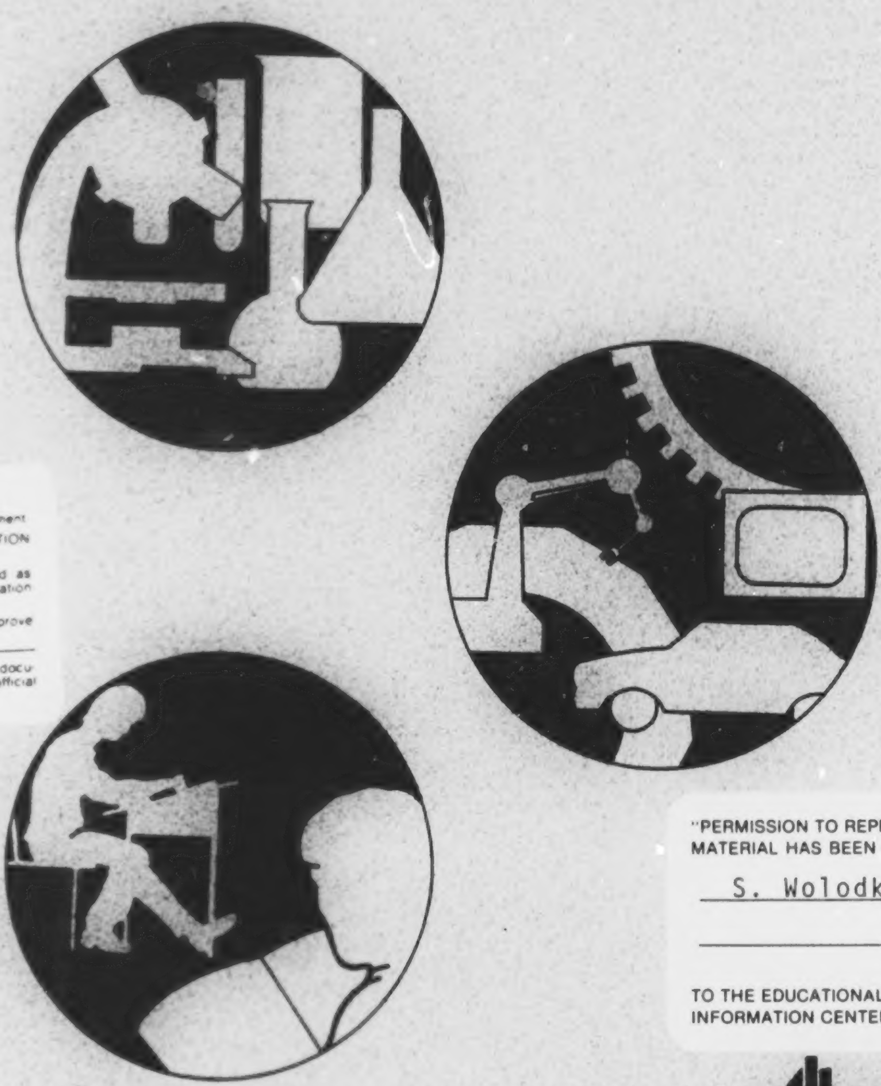
SCIENCE 20–30

BACKGROUND, EXEMPLARS AND RESOURCES



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Senior High Field Validation Teachers

Approximately 135 senior high science teachers from across Alberta participated in the project, and we thank them for their professional advice and efforts throughout.

Alberta Education, Curriculum Branch

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PREFACE

Science 20–30 Background, Exemplars and Resources is designed to provide practical information for teaching the Science 20–30 Program of Studies, which outlines what students are required to learn.

BACKGROUND

The Background section provides an overview of Science 20–30 explaining the program philosophy and objectives as well as clearly demonstrating how the program articulates with the junior and senior high science courses. The following two sections provide strategies for the use of concept connections and teaching a course around locally developed themes. Although these units are specifically in a Science 20 context they model approaches appropriate to Science 30.

EXEMPLARS

Exemplars are lesson outlines that closely follow the learning cycle set out in the specific learner expectations section of the Science 20–30 Program of Studies. They provide models of how Science 20 classroom activities can be structured to effectively accomplish the program objectives and include suggestions for assessment and evaluation of such activities. The strategies can be easily generalized to the Science 30 situation.

RESOURCES

The resource lists in this section provide detailed information on a great variety of resources that support the implementation of this program. These resources include authorized teaching background resources, basic student learning resources, support learning resources for students and many other resources not authorized but deemed useful for specific parts of the Science 20–30 program. As far as possible resources are keyed to specific units of study. Detailed annotations, distributor information and approximate prices for each resource listed are provided.

A senior high science teacher will find it useful to have both the *Senior High Science Teacher Resource Manual,* 1992 (Interim) and the *Science 20–30 Background, Exemplars and Resources,* 1994. The two are designed to work together, avoiding repetition of material common to all science programs.

The following documents support the senior high science curricula:

Science 16 Teacher Resource Manual, 1990 (Interim)
Science 26 Teacher Resource Manual, 1991 (Interim)
Science 14–24 Teacher Resource Manual, 1989
Senior High Science Teacher Resource Manual, 1992 (Interim)
Science 10 Teacher Resource Manual, 1992 (Interim)
Biology 20–30 Background, Exemplars and Resources, 1994
Chemistry 20–30 Background, Exemplars and Resources, 1994
Physics 20–30 Background, Exemplars and Resources, 1994
Science 20–30 Background, Exemplars and Resources, 1994

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BACKGROUND

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BACKGROUND TO THE SCIENCE 20–30 PROGRAM

by Dr. Oliver Lantz

AN INTEGRATED SCIENCE CURRICULUM

An integrated curriculum is one that gives both the knowledge of existing frameworks and the desire and power to create new ones.

In an integrated approach to science education, discipline boundaries are viewed as artificial human constructs and the fundamental unity of scientific thought is emphasized by organizing the science curriculum around themes; e.g., major concepts, science processes, persistent problems or issues, that transcend traditional science discipline boundaries. The integrated approach has two main goals—to provide learners with a framework that nurtures meaningful organization of unstructured facts, and to develop the learners' abilities to perceive and create new structures for themselves. An integrated curriculum is one that gives both the knowledge of existing frameworks and the desire and power to create new ones.

Interest in integrated science education has resulted from the realization that an integrated approach more accurately reflects the nature of science and has considerable educational value. The blurring of boundaries between traditional sciences is illustrated by the current expansion of science knowledge where major advances in scientific research are now taking place in interdisciplinary areas, such as geophysics, astrophysics and biochemistry. An integrated science curriculum reflects science, as it is known by modern scientists, better than a discipline-oriented science curriculum. Curriculum studies indicate that integrated science contributes to development of scientific literacy and student understanding of the social aspects of science.

The development of the integrated science approach is motivated by the belief that there exists a fundamental unity of thought in the enterprise of science and that this should be reflected in the science curriculum; that is, the study of science may vary in direction but not in methodology, because the fundamental concepts, skills and attitudes of science are common to all areas of investigation.

The introduction of the Science 10 and Science 20–30 programs in Alberta provides an opportunity for teachers to move out of their particular discipline of expertise and explore with their students the larger field of science. This is not as difficult as many teachers might imagine, if the focus is placed on the themes common in all areas of science. To take advantage of the opportunities provided by this approach, themes that integrate the units of the Science 10 and Science 20–30 programs need to be emphasized. The integrative themes come from the science content, from the nature of the science, and from the interactions of science with technology and society.

The Science 10 and Science 20–30 programs emphasize major concepts, scientific process skills and scientific attitudes, which provide common threads that run through all units of study. The big ideas of science; e.g., matter, energy, systems, are the conceptual foundations linking the theoretical structures of various scientific disciplines. These conceptual foundations provide a means of showing the connections among the scientific disciplines. Conceptual foundations also provide a framework for teachers to show students how parts of what they are learning fit together logically, and to focus on the big ideas of science rather than memorization of seemingly isolated facts, and to ensure that fundamental concepts are covered in a science program. They can be used to link facts, theories and ideas that occur repeatedly within a unit, from one unit to another and from one course to another, and to communicate these links explicitly.

Conceptual foundations provide a framework for teachers to show students how parts of what they are learning fit together logically, and to focus on the big ideas of science rather than memorization of seemingly isolated facts.

The scientific skills and attitudes developed in Science 10 and Science 20–30 provide additional integrative themes. The scientific process skills, which are common to all parts of the science curriculum, include questioning; proposing ideas; designing experiments; and gathering, processing and interpreting evidence. By illustrating that the processes of scientific investigation are similar despite the particular discipline framework, the unified nature of the scientific enterprise is emphasized. Similarly, emphasis on the positive scientific attitudes of critical-mindedness, suspended judgment, respect for evidence, honesty, objectivity, willingness to change, open-mindedness and questioning, are threads that run through the entire science curriculum.

The context in which science material is presented also provides a means of integrating the Science 10 and Science 20–30 program. A nature of science context provides an opportunity to illustrate how scientific knowledge is developed. For example, the role of empirical evidence in developing and revising theories is the same whether the content is biology, chemistry, physics or Earth sciences. Similarly, common elements emerge when the interactions of science and technology, and the role of science and technology in societal decision making are used as the context for teaching science.

Integrated science provides a means of reducing the sheer amount of material covered, to foster a scientific way of thinking, and to pay more attention to the nature of science and the interactions of science and technology with each other and with society. Science is often presented as a

This does not mean that the curriculum needs to be organized around themes; rather, the curriculum should be permeated by themes.

catalogue of facts, a cavalcade of activities that are seemingly unrelated. Themes can be a useful way to bring cohesion and unify scientific concepts. In integrated science curriculums, such as Science 10 and Science 20–30, many opportunities exist to show how the individual disciplines are connected by thematic strands. This does not mean that the curriculum needs to be organized around themes; rather, the curriculum should be permeated by themes.

Themes can be used to lay out the basic principles of science operating in many fields and subfields. Consider the theme of energy. In the current Science 10 course, the theme of energy is introduced in the context of solar energy sustaining life and driving the weather on Earth. The second unit illustrates the importance of energy in life processes, in particular, the cell. The third unit investigates the interaction of matter and energy in chemical reactions. The final unit in Science 10 examines different forms of energy and the principles governing energy transformations. In this manner the student learns about energy in a variety of different contexts; that the basic concepts related to energy can be applied widely in several disciplines; and that energy is a major overarching idea of science. This is an example of horizontal use of a theme that cuts across disciplinary boundaries. If themes recur from one year to the next or from one course to another, as is the case with energy; e.g., energy from the biomass in Science 20, and energy systems in Science 30, then the student will again see the unity of seemingly diverse concepts relating to energy. This progression of understanding from one course to another, as in Science 10 and Science 20–30, is an example of vertical integration of themes.

PROGRAM ARTICULATION

Both the junior and senior high school science programs emphasize the interaction among science, technology and society.

It will be helpful for science teachers at all grade levels to be aware of the articulation between the junior and senior high school science programs. Both the junior and senior high school science programs emphasize the interactions of science, technology and society. The differences between the two programs have to do with developmental needs and abilities in students at the two levels. Where the junior high approach is one of developing operational understandings, the senior high program tends to be more analytical and goes much farther in developing abstract understandings of the nature of science, the nature of technology, and the interactions among science, technology and society. The units of study for the two programs follow.

Junior High Science

Science 7

1. Characteristics of Living Things
2. Structures and Design
3. Force and Motion
4. Temperature and Heat Measurement
5. Micro-organisms and Food Supplies
6. Evidence of Erosion

Science 8

1. Solutions and Substances
2. Energy and Machines
3. Consumer Product Testing
4. The Earth's Crust
5. Growing Plants
6. Interactions and Environments

Science 9

1. Diversity of Living Things
2. Fluids and Pressure
3. Heat Energy: Transfer and Conservation
4. Electromagnetic Systems
5. Chemical Properties and Changes
6. Environmental Quality

Science 10 and Science 20–30

Science 10

1. Energy from the Sun
2. Energy and Matter in Living Systems
3. Energy and Matter in Chemical Change
4. Change and Energy

Science 20

1. The Changing Earth
2. Changes in Living Systems
3. Chemical Changes
4. Changes in Motion

Science 30

1. Living Systems Respond to Their Environment
2. Chemistry in the Environment
3. Electromagnetic Energy
4. Energy and the Environment

CONCEPT CONNECTIONS IN SCIENCE 20

by Bob Ritter

CONCEPTUAL FRAMEWORKS FOR DEVELOPING AN UNDERSTANDING OF CHANGE BY INVESTIGATING CONSERVATION OF MASS

Change is the theme common to all units in Science 20. Analysis of change is essential for understanding what is happening and for predicting what will happen in physical and biological systems. Inextricably linked with an understanding of physical, chemical and biological transformations is the development of the concepts within a framework that recognizes that matter is conserved. Students often construct contradictory frameworks because some empirical evidence suggests that matter is not conserved during change.

Commonplace descriptions about using food—matter—for energy, add to the idea that mass can be converted into energy by the human body.

Does the heat of a burning candle destroy the wax molecules? Many students will suggest that mass has been converted to energy. Undoubtedly, the candle has less mass after combustion, but does this mean that mass is destroyed? Copper, when heated, turns black. The black colour is accompanied by an increase in mass. Does this mean that the copper actually gains mass during chemical reactions? Decomposition of plant and animal matter seems to cause a reduction in mass. What happens to the matter after an organism dies? Trophic pyramids seem to indicate that mass is lost as energy. The biomass of producers is greater than that of first order consumers, which in turn is greater than that of second order consumers. What happens to the mass of a producer and first order consumer after it is eaten? Commonplace descriptions about using food—matter—for energy, add to the idea that mass can be converted into energy by the human body. The mass of reactants is considered to be greater than that of the products.

Unfortunately, misconceptions about conservation of mass are not restricted to chemical reactions—phase changes are also explained in terms of increases and decreases of matter. Some students will explain different densities of ice and water by suggesting that water molecules are heavier than ice molecules. The conversion of water to ice involves the loss of mass, while the conversion of ice to water involves the addition of mass. The ambiguity of everyday language may also lead students to develop alternative frameworks. Consider the statement that water is heavier than ice. In this context, heavier could be interpreted as greater density or greater mass. Two students with identical answers could have formulated different meanings. By indicating that ice is lighter than water, one student might assume that the molecule has lost mass—things do get smaller when cooled. The tendency, for most teachers, is to interpret lighter to mean less dense. Rarely would students be asked to explain what they mean by lighter.

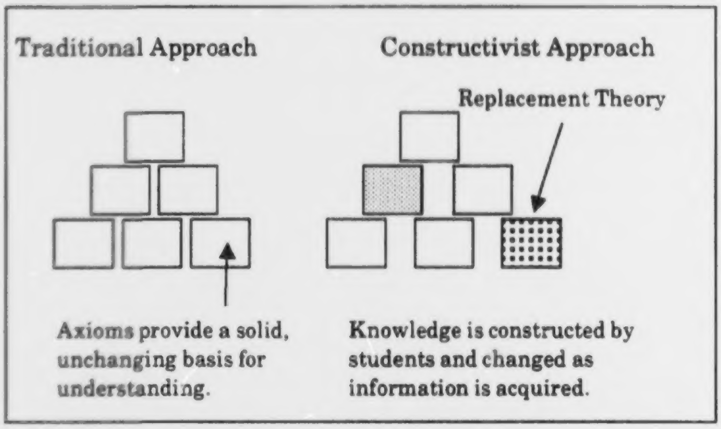
Even the empirical evidence provided by changing the Earth seems to indicate that matter is not conserved. Fossils appear to gain mass with aging, while radioactive isotopes appear to lose mass with aging. The melting of ice caps, the erosion from mountain ranges and sinking of some islands provide empirical evidence which might suggest that matter is lost from Earth's surface. In addition, the everyday language used to describe earthquakes in terms of structures being swallowed by the Earth, tend to propound a principle suggesting that matter is not conserved.

The tendency to avoid potential misconceptions by providing a complete answer, usually amplifies the separation of science as "taught" from "lived experiences". Students tend to accept scientific definitions of things, such as "chemical change" or "conservation of mass", as having meaning in science classes, but often reject their meanings, or fail to acknowledge them, when dealing with technological applications beyond the domain of the classroom. For example, during the burning of a candle, many students reason that because the mass of the candle has decreased, some mass must have been converted to energy. Logic seems to dictate that if the fire is energy and the wax has decreased during combustion, then the burning of the wax must have produced the energy. Therefore, the energy came from the candle wax.

Students tend to accept scientific definitions of things, such as "chemical change" or "conservation of mass", as having meaning in science classes, but often reject their meanings, or fail to acknowledge them, when dealing with technological applications beyond the domain of the classroom.

An approach that stresses the linear, incremental building of scientific knowledge and fosters the idea that an understanding of science begins with a sequential linking of details only magnifies the problem. This view of scientific knowledge is analogous to building a pyramid, in that a solid base must be established before students can begin adding progressive levels of understanding. At the base of the pyramid are irrefutable truths or axioms, which have been tested by time. These axioms become the factual basis on which an understanding is built. The recognition of linkages is often relegated to the teacher, and teacher-directed lessons dominate curriculum discussions and the organization of knowledge. Inherent within this approach is an underlying assumption that curriculum as "taught", parallels curriculum as "learned". A second assumption is that the correct axiom or truth is used to build an understanding.

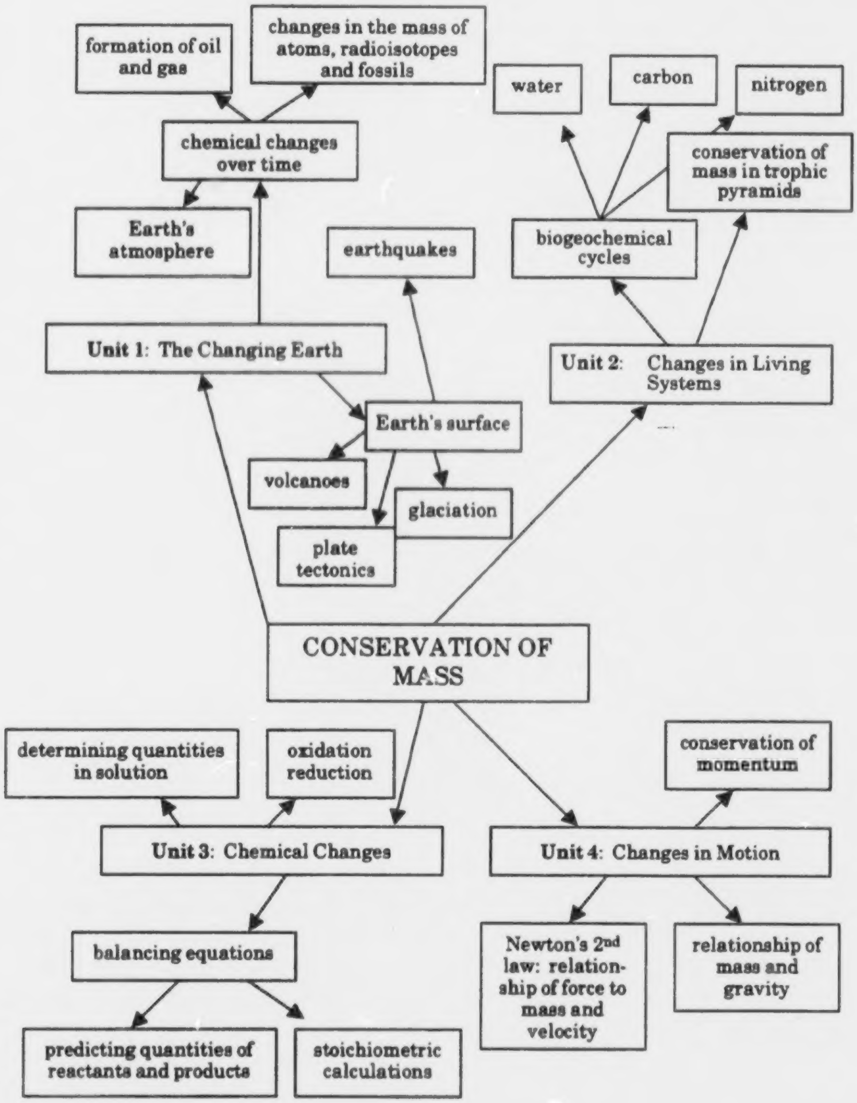
Science 20 provides students with an opportunity to construct their own meanings, recognizing that future experiments and discussions will cause them to challenge some of their previous notions. The teacher acts as a catalyst by providing opportunities for students to rework their understandings. The approach also acknowledges that prior learning has occurred and that many frameworks already exist for explaining change. The junior high school and Science 10 programs introduce change (Grade 8, Unit 1: Solutions and Substances; Science 10, Unit 3: Energy and Matter in Chemical Change). Previous formalized learning and everyday lived experiential learning are woven into a fabric of understanding.


Traditional Approach
Constructivist Approach
Replacement Theory
Axioms provide a solid, unchanging basis for understanding.
Knowledge is constructed by students and changed as information is acquired.

As students construct a knowledge base, gaps are found within their understanding. The traditional approach provides a solid basis prior to application and assumes that student learning parallels teaching. A constructivist approach requires the re-examination of beliefs and assumptions as knowledge is formalized. The foundations for understanding are either reinforced or changed as knowledge is constructed.

The constructivist approach also recognizes that some flaws will be encountered as students begin building a basis of understanding. Should we return to the analogy of the pyramid, students using this approach will identify difficulties or imperfections in the structural basis as they begin to build further levels of understanding. Existing assumptions will be challenged and scientific knowledge will be reorganized to provide a more solid basis. As each level of application is added, the theories and assumptions that underlie the framework of understanding must be re-examined to ensure that the knowledge base supports applications. Unlike a traditional view of science which presupposes that scientific knowledge is constructed on irrefutable axioms, this view presupposes that knowledge is tentative and socially constructed.

The concept map below shows how the conservation of mass can be interwoven into the four units of Science 20.


formation of oil and gas
changes in the mass of atoms, radioisotopes and fossils
water
carbon
nitrogen
chemical changes over time
conservation of mass in trophic pyramids
Earth's atmosphere
earthquakes
biogeochemical cycles
Unit 1: The Changing Earth
Unit 2: Changes in Living Systems
Earth's surface
volcanoes
glaciation
plate tectonics
CONSERVATION OF MASS
determining quantities in solution
oxidation reduction
conservation of momentum
Unit 3: Chemical Changes
Unit 4: Changes in Motion
balancing equations
Newton's 2nd law: relationship of force to mass and velocity
relationship of mass and gravity
predicting quantities of reactants and products
stoichiometric calculations

The emphasis placed on the big themes, such as change, underscore the idea that the complete picture cannot be provided by the incremental accumulation of "facts". Beginning with large unifying concepts, such as the conservation of matter, students develop frameworks to acquire knowledge about the manner in which changes occur.

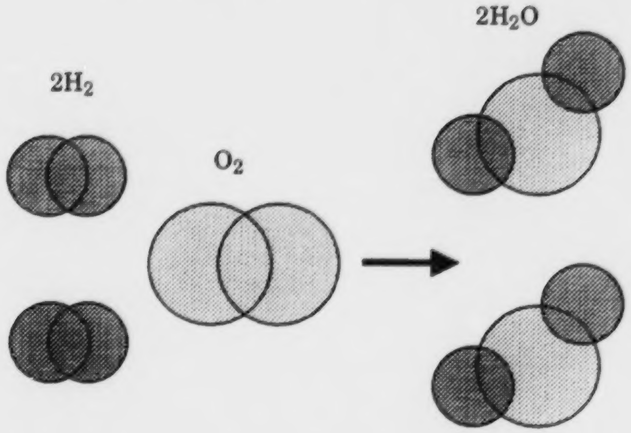
Some misconceptions arise because students find it difficult to imagine what is happening on a molecular level.

Some misconceptions arise because students find it difficult to imagine what is happening on a molecular level. These students often confuse molecules with atoms. Chemical changes, which involve a change in molecular structure, are often interpreted and expressed as changes in atomic mass. Although some molecules in the products may be larger than any of the molecules in the reactants, the number of atoms found in reactants and products does not change. Atoms are merely reorganized. This misconception is reinforced by empirical evidence from chemical changes that focus mainly on the mass of one of the reactants or one of the products, rather than considering the total mass of reactants and products within a closed system. The total mass of reactants and products remains unchanged.

In Unit 1: The Changing Earth, students have an occasion to examine conservation of mass on a very large scale. Consider how the spewing of lava from a volcano could initiate a discussion about whether the molten rock came from the thermal energy. Some students may suggest that if mass can be converted into energy then the reverse process might also be possible. That is, energy can be converted into mass. The notion that thermal energy could give rise to lava would likely be rejected. In turn, this would serve as a way of approaching the reverse transformation, the concept that mass can be converted into heat.

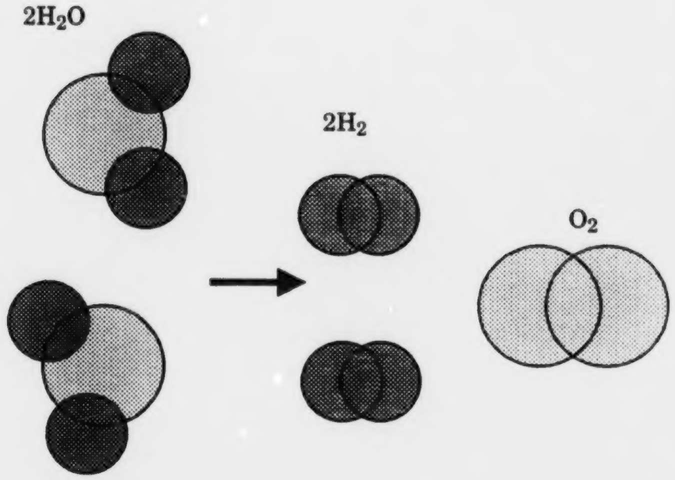
In Unit 2: Changes in Living Systems, students begin to understand how nitrogen combines with oxygen, carbon and hydrogen atoms to form nitrides, nitrates, and finally amino acids and proteins as part of the nitrogen cycle. Although proteins are extremely large molecules, having a mass much greater than that of individual nitrogen, hydrogen and oxygen molecules, the number of atoms found in reactants is always equal to the number found in the protein. Other biogeochemical cycles provide a similar opportunity.

In Unit 3: Chemical Changes, provides an opportunity to synthesize many of the frameworks developed in Unit 1 and Unit 2 by addressing conservation of mass on a molecular and atomic level. Consider the formation of water from oxygen and hydrogen. If students were able to shrink themselves about five billion times, they would be able to watch the formation of water. Unfortunately, chemical reactions occur faster than the human eye can focus. During the reaction, molecules of hydrogen and oxygen collide and rebound. Occasionally, the molecules break bonds and new bonds are formed. The diagram below shows what happens when hydrogen combines with oxygen.



Students who do not differentiate between atoms and molecules will not understand why one molecule of oxygen can form two molecules of water. These students may want to use only one atom of oxygen as a reactant. To help them confront this popular misconception they may be asked to consider why oxygen atoms do not exist as an element in nature. Oxygen atoms are far too reactive. Oxygen atoms combine with other oxygen atoms to share electrons and form a diatomic molecule of oxygen. This means that they are never dealing with a single oxygen atom. Hydrogen, like oxygen, also exists as a diatomic molecule. The diagram above shows that two molecules of hydrogen combine with one molecule of oxygen to form water. They may notice that the number of oxygen atoms and hydrogen atoms, used as reactants, equals the number of oxygen atoms and hydrogen atoms found as products.

Students might be asked to compare the formation of water to the decomposition of water. The diagram below shows that two molecules of water form one molecule of hydrogen and two molecules of hydrogen. Although two molecules are transformed into three molecules the total number of atoms never changes. All that changes in the chemical reaction is the manner in which the chemicals are arranged.



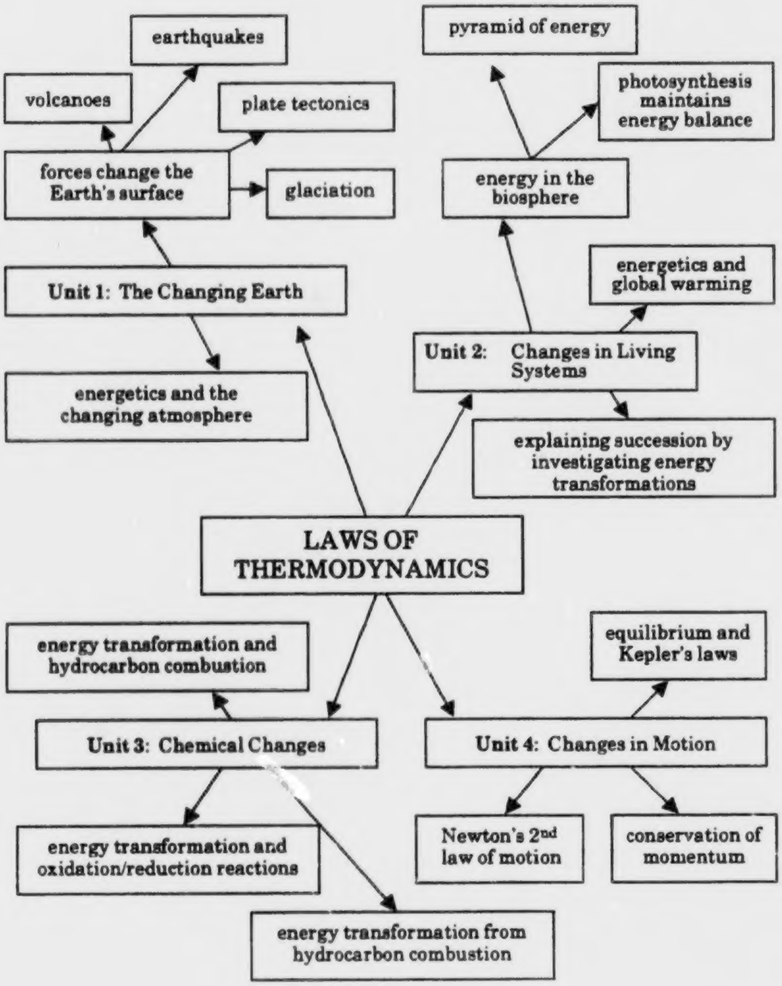
In Unit 4: Changes in Motion, bridges many of the concepts between conservation of mass and energy. By presenting learning situations that examine the relationships among force, mass and acceleration, within the framework of Newton's second law, students begin to develop an understanding of gravitational forces and the movement of planets and satellites.

CONCEPTUAL FRAMEWORKS FOR DEVELOPING AN UNDERSTANDING OF CHANGE BY INVESTIGATING THE LAWS OF THERMODYNAMICS

The first law of thermodynamics indicates that the total amount of energy in the Universe remains constant. Additional energy cannot be made. Existing energy cannot be destroyed; however, it can be converted from one form into another. Students tend to think of energy in terms of useful energy that accomplishes work. Energy that is not converted into useful energy, or waste energy as it is sometimes called, is often incorrectly described as being lost. Although the energy may be lost from the system, it is not lost from the Universe. Energy systems are most often described in terms of input energy, transformation, such as by a technological device, and output energy. Usually, only a portion of the output energy is used to the desired effect.

According to the second law of thermodynamics, energy can be described as flowing from high quality energy forms to low quality energy forms. The flow of energy will occur without any interference, whether it takes a few milliseconds or millions of years. In every situation, the energy will be transformed into less organized forms. Each time energy is transformed, some of the energy is randomly dispersed in a form that is not available to perform work. This form is most often heat. While the first law indicates that energy cannot be created or destroyed, the second law explains why some useful energy is always lost from a system during energy conversions. Entropy describes the disorder of a system. Following the tenets of the second law of thermodynamics, entropy in an isolated system tends to increase over time unless energy is added to the system to restore order. The Universe is said to be moving toward a state of maximum entropy or random disorder.

The concept map below shows how the laws of thermodynamics can be interwoven into the four units of Science 20.


earthquakes
volcanoes
plate tectonics
forces change the Earth's surface
glaciation
pyramid of energy
photosynthesis maintains energy balance
energy in the biosphere
Unit 1: The Changing Earth
energetics and global warming
energetics and the changing atmosphere
Unit 2: Changes in Living Systems
explaining succession by investigating energy transformations
LAWS OF THERMODYNAMICS
energy transformation and hydrocarbon combustion
equilibrium and Kepler's laws
Unit 3: Chemical Changes
Unit 4: Changes in Motion
energy transformation and oxidation/reduction reactions
Newton's 2nd law of motion
conservation of momentum
energy transformation from hydrocarbon combustion

The emphasis placed on the big themes, such as change, underscore the idea that the complete picture cannot be provided by the incremental accumulation of "facts". Beginning with large unifying concepts, such as the first and second laws of thermodynamics, students develop frameworks to acquire knowledge about the manner in which changes occur.

In Unit 1: The Changing Earth, earthquakes and plate tectonics provide excellent examples of how the Universe is moving toward disorder. The second law of thermodynamics also provides a framework for explaining volcanoes, convection currents and the changing atmosphere.

In Unit 2: Changes in Living Systems, students begin to understand why energy is lost by each trophic level of the energy pyramid. Ecosystems are considered to be open systems because heat—waste energy—is lost with each energy transformation. A steady flow of sunlight energy is required to compensate for the energy lost from the biosphere. The biotic world maintains a high degree of organization only because energy is added to this open system by the Sun.

In Unit 3: Chemical Changes, provides unity for many of the concepts that may have been developed independently in Unit 1 and Unit 2. Empirical knowledge, gained from balancing chemical equations, identifying the reactants and products of oxidation/reduction reactions, and hydrocarbon combustion reactions, and the quantitative gravimetric and stoichiometric calculations, enable students to examine the first and second laws of thermodynamics.

In Unit 4: Changes in Motion, applies the first and second laws of thermodynamics to motion and momentum. Newton's first, second and third laws of motion indicate that changes can be brought about if energy is added to a system, and that useful energy can be lost from a system during energy conversions. Applications from Newton's first law of motion, which states that every body persists in a state of rest or uniform motion in a straight line, unless acted upon by an external force, reinforce the principle of conservation of energy. An object will not move unless energy, from an external source, is added to the system. Similarly, the principle of inertia indicates that once the energy is applied, the objects will continue to move, unless another force, external to the system, is applied to impede the object. The fact that friction slows a rolling ball is reinforced by the second law of thermodynamics, which addresses energy conversions and the loss of heat—the random dispersion of energy—entropy. Newton's second law, which can be expressed mathematically as, force = mass × acceleration, allows students to relate force, mass and motion. This relationship enables students to construct meanings for relating a change in momentum to acceleration. Newton's third law, which states that for every reaction there is an equal and opposite reaction, builds upon what students have learned about momentum and examines what happens when objects interact. Momentum is conserved during physical interactions—conservation of momentum.

UNIFYING SCIENCE 20 AROUND LOCALLY DEVELOPED THEMES

by David Blades

INTRODUCTION

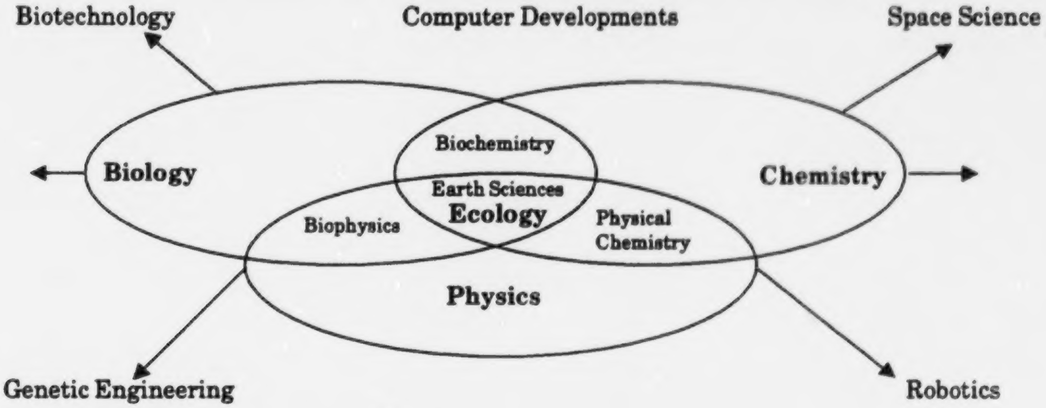
During my first year as a high school science teacher I had the opportunity to sit on the front steps of our school and discuss educational philosophy with our principal. As we shared our ideas, the principal suggested that in my career I always remember to be "a teacher first, a subject specialist second." Over time, I have come to realize that this perspective to teaching represents a call to constant excellence: there are always better, more effective, more innovative ways to help students learn. This search for improvement in teaching and learning may lead some science teachers to consider non-traditional approaches to science education. One highly effective, unusual approach offered to teachers in the Science 10 and Science 20–30 programs is the opportunity to unify particular science courses around locally developed themes.

What Is a Unified Approach to Science Education?

A considerable confusion of terms surrounds the various approaches to science education. Labels, such as "integrated science", "thematic approach", "interdisciplinary science education", "holistic science", and "multidisciplinary approach" can all be synonymous with "unified science", or vary slightly depending upon the philosophical bias of the user. Regardless of use, each term refers to how the topics in a science program are organized. The most traditional, and common, organization of science education is to study topics in a high school science program within their respective science disciplines. This disciplines approach emphasizes the fundamental structure of the science disciplines in a science program; thus, students find topics in their science education in the familiar courses of biology, chemistry, physics or Earth sciences.

There are several problems with a strict disciplinary approach to science, even at the high school level of science education. The rapid growth of scientific knowledge during the twentieth century has caused the boundaries of traditional science disciplines to become increasingly blurred. Overlap among disciplines has created fields of study reflecting two disciplines at once, such as biomechanics or physical chemistry. Ecology and Earth sciences often involve aspects of all three disciplines. Emergent areas of research, such as genetic engineering, robotics and space science, demand an understanding of science that pushes the boundaries of traditional science even further.

CHANGE IN TRADITIONAL SCIENCE BOUNDARIES



Even though the classical science disciplines are evolving many broad interdisciplinary connections, the fundamental unity of science is reflected by characteristics, such as the value of questioning, respect for logic, and the demand for verification and reliability that typify a scientific way of thinking. Many conceptual parallels exist among science disciplines; for example, the use of a classifying flow chart in chemistry is similar to the use of a classification key by a biologist. Broad, interconnecting ideas, or "themes", that exist among science disciplines reflect the modern view that science is a unified human activity that varies in point of application, not in approach.

To help students gain a modern view of science and an appreciation of the evolving nature of scientific knowledge, the Science 10 and Science 20–30 programs allow students to experience each of the major science disciplines while emphasizing the interconnecting themes among each. The following illustration shows how the units found in Science 20 reflect major science disciplines.

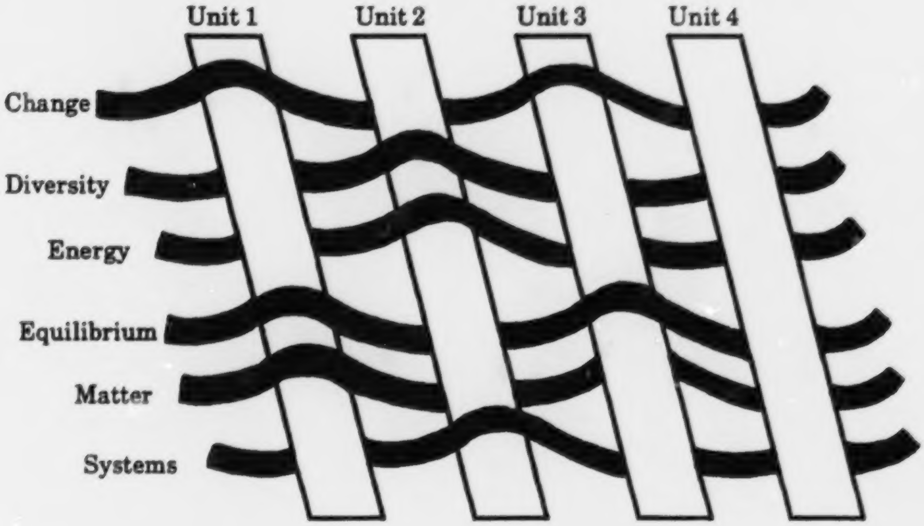
SCIENCE 20 TOPICS BY UNIT

Unit 1: The Changing Earth	Unit 2: Changes in Living Systems	Unit 3: Chemical Changes	Unit 4: Changes in Motion
• forces within Earth cause continual changes on the surface • paleontology • the fossil record and evolution • ice ages and glaciation	• cycles of matter in ecosystems • energy flows in ecosystems • characteristics of ecosystems • change over time in an ecosystem • adaptation over time of organisms to their environments	• aqueous solutions • quantitative equations in chemical reactions • oxidation and reduction • hydrocarbon chemistry	• describing the motion of objects • Newton's laws of motion • circular motion • conservation of momentum

Clearly, Unit 1 is oriented toward Earth sciences; Unit 2, the biological sciences; Unit 3, chemical sciences; and Unit 4, the physical sciences. Yet, within the Science 20 course are woven some of the major conceptual themes common to all science disciplines. The illustration below shows how themes weave through Science 20 topics.

THE WEAVING OF THEMES THROUGH SCIENCE 20 UNITS

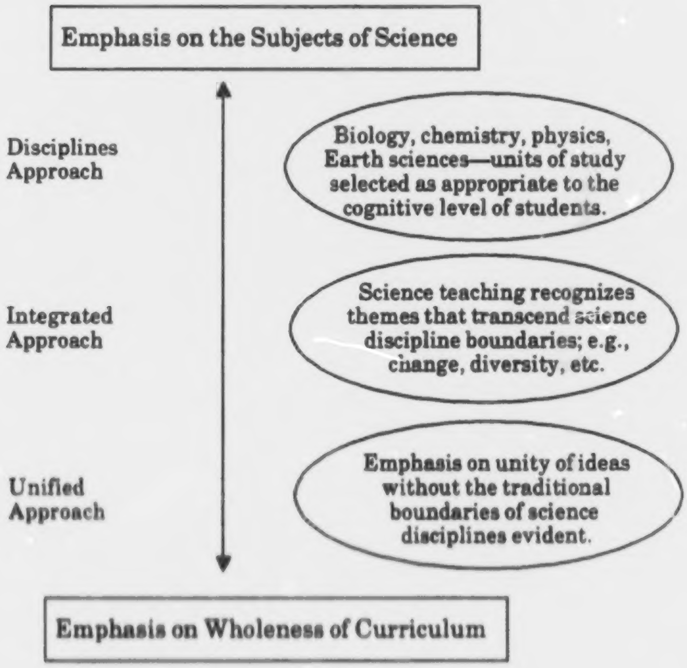
Knowledge, Skills and Science–Technology–Society Connections



The use of interconnecting themes, while retaining the structure of traditional science disciplines within units of study, is called, in Alberta, an "integrated approach" to science education. For more information on an integrated approach and how to emphasize the six major themes presented in Science 20, please see the *Senior High Science Teacher Resource Manual*,1992 (Interim), Section 3K.

A unified approach to science education takes an integrated approach one step further by disregarding altogether the grouping of science topics by traditional science disciplines. According to the director of the Centre for Unified Science Education (U.S.A.), a "unified science" course unites topics previously separated into science disciplines through the use of themes revolving around a major concept, science processes or a particular problem. Unified science education encourages the reorganization of topics around locally developed themes; science disciplines typically receive little emphasis or, more commonly, disappear altogether in the organizational structure of a unified science course. A spectrum of science education approaches showing the relationship of a unified approach to the integrated approach and the disciplines approach follows.

SPECTRUM OF SCIENCE EDUCATION APPROACHES



Emphasis on the Subjects of Science

Disciplines Approach

Biology, chemistry, physics, Earth sciences—units of study selected as appropriate to the cognitive level of students.

Integrated Approach

Science teaching recognizes themes that transcend science discipline boundaries; e.g., change, diversity, etc.

Unified Approach

Emphasis on unity of ideas without the traditional boundaries of science disciplines evident.

Emphasis on Wholeness of Curriculum

A unified approach to science education is not new, but has increased in popularity in the past thirty years. Locally developed, unified science programs emerged in Canada and the United States during the decades from 1940 to 1960. Unified and integrated approaches were smothered while still in their infancy by the science curriculum reform megaprojects of the sixties, such as CHEMstudy, Biological Sciences Curriculum Study (BSCS), Physical Science Study Committee (PSSC), and the various regional and provincial adaptations that resulted. Renewed interest in integrated and unified science courses was stimulated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) division of science teaching. In 1968, UNESCO convened a worldwide conference on science teaching that led to a series of international symposia to help promote exchange and deliberation about integrated and unified science education. In the United States, this approach has been stimulated since 1966 by the Federation for Unified Science Education (FUSE), since 1975 by the National

Science Teachers Association of the U.S.A. (NSTA), and since 1985, by the American Academy for the Advancement of Science (AAAS).

Canadian interest in integrated and unified approaches to science education was stimulated by UNESCO, developments in the United States, and the Nuffield Science Programs in Great Britain. The catalyst for deliberation in Canada was, in 1972, the introduction in some Saskatchewan schools, of the science program called *Science: A Way of Knowing*, and in the 1978 publication in British Columbia of a new junior high school science program promoting the unification of science topics around themes. From 1980 to 1984 interest was further stimulated by discussion papers published by the Science Council of Canada, and an international symposium on world trends in science education held in Halifax. Growing Canadian interest in integrated and unified science education has led Alberta Education to propose the first Canadian integrated science programs at the senior high school level, Science 10 and Science 20–30. While these courses still retain, by units, the traditional boundaries of science disciplines, the opportunity now exists to reorganize and unify science topics around locally developed themes.

AN EXAMPLE OF A UNIFIED APPROACH TO SCIENCE 20

The following illustration portrays one example of how Science 20 could be unified around two locally developed themes. In this example, topics to be explored in Science 20 are first connected to understanding the life, ecology, and extinction of the late Cretaceous carnivore *Albertosaurus*. This theme would be ideally suited to a group of students interested in paleontology and living near the Tyrrell Museum in the Drumheller area. Many students enrolled in Science 20 will be learning to drive, so the theme of the automobile connects topics as the second theme for Science 20. The example suggested would ideally suit a Science 20 course offered in a semestered program. An example of three themes that could be developed for a nonsemestered Science 20 will be given later. One of the many values of a unified approach is the myriad possible themes that could be used; when developing a unified Science 20 course, most teachers will develop their own, unique unifying themes based on the needs and interests of their students and the availability of local resources.

UNIFYING SCIENCE 20: SAMPLE THEMES 1

Uncovering a Dinosaur

- Paleontology in Alberta: discovery of fossils, tools and techniques; understanding geological time
- Fossil record and change: emergence and disappearance of Albertosaurus
- Fossilization and fossil fuel formation
- Ice ages: cycles and global warming
- Changes on Earth's surface today: plate tectonics, earthquakes, volcanoes, erosion

Life of a Carnivore: Albertosaurus

Learning from the Past

- Review of Science 10: greenhouse effect
- Analysis of a local ecosystem for acid/base pollution, dissolved oxygen, etc.
- Comparing/contrasting an ecosystem today to late Cretaceous
- Issue: are humans facing their own extinction?

Life and Death in the Late Cretaceous

- Movement of matter and energy in a biosphere
- Ecosystem and adaptations in Alberta during the late Cretaceous
- Change in ecosystems: what killed the dinosaurs?

How an Automobile Engine Works

- Hydrocarbons as fuel: properties, family and uses of hydrocarbons
- Stoichiometry and fuel use in an internal combustion engine
- Pistons, transmissions and drive train: chemical energy to mechanical energy
- Basic automobile maintenance

The Automobile

Convenience or Crisis?

- The greenhouse effect and the gasoline engine
- Toxic products of fossil fuel use
- Finding alternatives: oxidation and reduction applied to designing efficient battery-powered automobiles

The Motion of an Automobile

- Newton's laws applied to automobile motion: inertia, force, momentum, fuel efficiency
- Automobile accidents as one-dimensional collisions; conservation of momentum
- Safety in automobile use: seat belts, air bags, speed limits

WHAT ARE THE BENEFITS OF A UNIFIED APPROACH TO SCIENCE EDUCATION?

Philosophical Benefits

Except through locally developed programs, such as ALCHEM and Science, Technology, Society and Communication (STSC) chemistry programs of study in Alberta, there has been little recent attempt to relate the philosophy of science education to the philosophy of science. By stressing the interrelationships of topics around a central theme, students in a unified course will begin to understand science as a unified human activity that connects with and relates to other activities. This understanding reflects the philosophy of unity in scientific thinking and the fundamental interconnectedness of the Universe, captured succinctly and humorously by American naturalist John Muir who once noted that "when you reach out into the world and grab hold of something, you find it hitched to something else." According to science educator Joseph Schwab, one way modern science education could relate to the philosophy of science is to focus in science courses on the points of contact and connection among things and ideas by portraying phenomena and ideas not as things in themselves, but as fulfillments of a pattern. Through the use of locally developed themes, a unified science course provides the ideal vehicle to study science topics as interconnected parts of larger patterns. Through the use of themes, the philosophy of "pattern making" in science education reflects the idea of unity in the philosophy of science, forming bridges between philosophical considerations in science and science education.

Social Critical Benefits

An emphasis on patterns and connections in a unified science program leads instruction naturally toward explorations with students of connections existing between science and social issues. Science educator Paul Hurd argues that discipline-centred science courses are often too restricted, fragmented and hierarchical to focus on the science-based social issues students must deal with as citizens. A science program unified around locally developed themes recognizes that the real-life problems and decisions students will face cut across science disciplines. In a unified Science 20 course, the structure of the course encourages students to see how issues are interrelated. For example, concepts introduced while students debate possible causes of dinosaur extinction (Theme 1: Uncovering a Dinosaur) will later reappear with a new perspective when debating whether or not automobiles are responsible for the "greenhouse effect". In both instances, students will see that atmospheric degradation is related to species extinction and evolution. The comparison of topics and the search for connections and insights tend to be quite dynamic in a unified approach. This dynamism encourages students to have a high degree of *critique*, where the scientific knowledge, processes, skills and literacy students develop are constantly related to the need to be informed, critical citizens.

Educational Benefits

The value of unifying topics in a science course around locally developed themes lies in the choice and practical expression of the organizing themes. Some of the educational benefits of using locally developed themes are touched upon below.

Unified science courses are locally developed.

Most of the material and resources available to Science 20 teachers and students reflect a disciplines approach to science education. This means that the development of a course outline for a unified, integrated science course depends on the ingenuity and perspective of the teacher and the students. Invariably, unified science courses reflect the unique characteristics of the local school environment by building upon student interest, available facilities and staff qualifications. What results is a course of study tailored to the unique situation of the region or school, often stimulating further curriculum development in the local school setting. Planning for a unified science course requires innovation that can be stimulating but also very demanding on teacher time and expertise; nevertheless, research indicates that, in general, teachers who developed unified science courses felt the experience was positive. In this setting of educational innovation and local relevance, it is little wonder that research indicates student enrollment in science increases when a unified approach is adopted in a school.

Unified science courses are relevant to students.

In a unified approach, each theme provides a context that is, ideally, situated in the life-world and concerns of students. For example, two major concepts from Science 20, Unit 3, oxidation and reduction reactions, and hydrocarbons, are considered in the context of the automobile. Redox reactions are applied to the topic of battery-powered automobiles, and the stoichiometry of hydrocarbon reactions in the context of understanding the function of an internal combustion engine. Each concept is grounded in the students' experience of automobiles, while presenting some of the debates about alternative transportation these students face as voters and consumers. With a concern for directly relating theme choice and development to student interest, it is not surprising that students characterize unified science courses as relevant, fun and exciting.

Unified science courses could become even more relevant to student interests by directly involving them in the choice of unifying themes. Students who enrolled in a unified Science 20 course one year could provide valuable insights into the appropriateness of themes studied; these students may suggest changes or new themes for the next Science 20 course. Students enrolled in Science 20 could choose in September the themes they would like to pursue, or teachers could select the first theme and allow students to choose the other themes to be developed later in the course. The dynamic of choice could include parental feedback, thus encouraging ownership and involvement in the development of the Science 20 curriculum by students and parents.

Unified science courses encourage flexible teaching methods.

The use of unifying themes can result in several topics in the science course being repeated in each theme. This allows the science teacher to emphasize certain topics or to explore the same topic from different perspectives. For example, the formation of hydrocarbons can be developed in the first theme, Life of a Carnivore, while the burning of hydrocarbons is studied during the second theme, The Automobile. Specific skills, such as laboratory safety or writing reports, can be woven throughout the science course. As students see connections among ideas, questions arise that can lead to interesting side discussions; students may wish to explore, as research projects, theories about dinosaur extinction or how police detectives determine blame in automobile collisions. Some themes could be taught inductively: students could be challenged to find out how chemical energy is converted to mechanical energy in an automobile engine. A team approach or cooperative learning could be used to help students develop a picture of the large freshwater ecosystem in Alberta during the late Cretaceous period. Students could debate if paleontology is worth the cost, or if humans are facing extinction. The use of connecting ideas allows tremendous variation on how these themes might be developed; teachers could research various approaches and techniques, furthering the local nature of the science course while developing dynamic, effective teaching methods.

Unified science courses stimulate intersubject cooperation.

Exploring the relationship between science topics and social concerns in a unified science course presents opportunities for cross-subject cooperation. During The Automobile theme, science teachers may wish to plan a joint Science 20–social studies session on the social impact of automotive technology. A joint Science 20–mathematics session might help students understand the chronological dimension of geologic time, while providing insight into the practical use of exponents.

The possibilities of cooperation with topics in other subject areas exist in all approaches to science education. By using two or three themes in a unified science course, more opportunities may exist to find points of contact between other subjects and science themes.

Classroom atmosphere is easily established with a unified approach to science education.

Even the most inartistic of science teachers can develop effective bulletin board displays and learning centres with a unified approach. For example, one teacher had an art student paint a full scale giant *Albertosaurus* head on the back wall of the science classroom. The gaping mouth of this carnivore prompted many comments from students! Simply collecting and posting pictures related to the particular theme provides easy decoration of a classroom while establishing interest in the theme and a sense of atmosphere. Sometimes these collages of pictures can be very effective in promoting discussions. To introduce the theme "Water" one imaginative teacher stapled pictures of clean water on one side of a bulletin board and pictures of water pollution on the other. During the development of the theme students often referred back to the pictures to make points about water pollution and the need for clean water. Learning centres featuring texts, slides, photographs, etc., are easily prepared, especially with the assistance of a teacher-librarian, when a theme provides the central organization for science topics.

Unified science courses often encourage success in further science studies.

Students choosing to study a particular science discipline after Science 20 will generally find they are well prepared. The focus on the nature and role of science pervading a unified Science 20 course provides a framework for understanding how science disciplines can be seen as extended themes. Certainly, research indicates college students who studied science from a unified approach during a secondary school science program obtain grades, in their first year, as good as or better than their peers who studied science from a disciplines perspective.

HOW TO UNIFY SCIENCE 20 AROUND LOCALLY DEVELOPED THEMES

Developing a unified Science 20 course is a cooperative, creative event. This event progresses through a number of stages, as follow.

Selecting Unifying Themes

Building a unified course begins by listing the topics in the Science 20 course of studies. This time-consuming task has been made easier by condensing a collection of these topics into a single chart, such as in Science 20 Topics Arranged by Science Disciplines, which follows.

Organizing Topics with Unifying Ideas

From these topics the teacher, often in collaboration with other teachers, and possibly students, chooses unifying themes that integrate the topics of the science course. These themes form the central core for the Science 20 course; all the other topics will be related to these unifying themes. There are unlimited unifying themes that could be used; teachers are encouraged to develop their own unified science courses to reflect the unique needs of their educational settings. Some of the characteristics teachers should consider when choosing effective unifying themes are:

- each theme should be simple and concrete
- each theme should fit naturally with the topics listed in the Science 20 course of studies
- the connections among the topics to be explored and the unifying themes should be straightforward and obvious to the student
- unifying themes should have relevance to student needs and interests.

This stage is crucial to the success of a unified science course. Once the two unifying ideas are selected, the topics of the science course are then organized and related to the unifying themes. **It is essential that no topics from the program of studies be omitted.** Some of the topics may appear in more than one theme, although often with a different perspective. What should result is a diagram listing topics of study and their relation to a unifying theme.

Some possible unifying themes for Science 20 might be:

- A case study; e.g., historical event in science, such as the discovery of Nylon 66; or a debate; e.g., cold fusion.

SCIENCE 20 TOPICS ARRANGED BY SCIENCE DISCIPLINES

Unit 1	Unit 2	Unit 3	Unit 4
• **forces within Earth cause continual changes in Earth's surface:** lithosphere, asthenosphere, mesosphere, theory of plate tectonics, earthquakes, volcanoes, seismic waves, early atmosphere of Earth	• **cycles of matter in ecosystems:** hydrologic cycle, biogeochemical cycles of carbon, nitrogen, oxygen	• **aqueous solutions:** solution formation, electrolytes, nonelectrolytes, acids and bases, concentration, solubility, dynamic equilibrium	• **describing the motion of objects:** displacement, time, velocity, acceleration, scalar and vector quantities, uniform motion and uniform acceleration
• **paleontology:** radiometric dating, fossils, sedimentary rocks, Precambrian, Paleozoic, Mesozoic, Cenozoic, evolution of $O_{2(g)}$	• **energy flows in ecosystems:** trophic levels, numerical or biomass pyramids, competition, predation, symbiosis	• **quantitative equations in chemical reactions:** mole ratios, balanced equations, gravimetric and solution chemistry, stoichiometry	• **Newton's laws of motion:** mass, volume and weight, force, Newton's three laws of motion, change in momentum and acceleration, impulse
• **the fossil record:** formation of fossil fuels, oil and gas reservoirs, genetic and natural selection and the fossil record, Darwinian evolution, punctuated equilibrium	• **ecosystem characteristics:** physiographic, climatic, edaphic and biotic factors	• **oxidation and reduction:** as defined, electrolytic and galvanic cells, half-reactions and stoichiometry	• **circular motion:** centripetal force, uniform circular motion, Newton's universal law of gravitation, planetary and satellite motion, Kepler's laws and Newton's laws
• **ice ages:** glaciation and topography, ice core sampling, possible causes of ice ages, ice ages and global warming	• **change in ecosystems over time:** primary and secondary succession, natural or artificial disturbance	• **hydrocarbon chemistry:** general characteristics of hydrocarbons, alkanes, alkenes, alkynes, combustion, addition, substitution, polymerization, fossil fuels, describing and naming petrochemical hydrocarbons	• **conservation of momentum:** linear collisions and explosions, conservation of angular momentum in a rotating object
	• **adaptation over time of organisms to their environments:** variation in species and populations, fitness and natural selection, limitations on population size		

- A detailed study of a natural phenomenon; e.g., lightning; or a living or extinct thing; or a scientific industrial process; e.g., paper manufacturing.

- An investigative study of a particular problem; e.g., local waterway and fertilizer run-off.

- Research a major invention, past, present or possibly in the future; e.g., light bulb, robotics, genetic engineering, moon base.

- An exploration of a controversial issue, such as the promotion of uranium mining and the development of nuclear power stations.

- The creation of political action groups. For example, students could be arranged into science advisory committees at the local, provincial, national and international level to examine particular issues and make recommendations.

Building Expanded Unified Courses

The final stage to designing a unified science course involves expanding the topics into a coherent course. What develops is a course outline listing the central, unifying theme and the related subtopics, with a subsequent breakdown of the topics from the Science 10 and Science 20–30 programs of study. Teachers have found cooperative planning helpful at this stage in the development of a unified course. Studies have found two unifying themes per semestered course and three for a year-long program work well, although less or more themes could be possible. A sample Science 20 Course Outline, based on three themes, follows the Summary.

Contacting School Administration

Unifying Science 20 around locally developed themes is a departure from customary structure. It is recommended that plans to develop such a course be discussed with the department head and/or school administration. Teachers should be prepared to show how all the topics in the Science 20 course of studies are considered in the unified course. Discussions with administration might also point out how a unified approach involves science teaching as ongoing curriculum research, involving the insights and opinions of students and parents.

A SECOND EXAMPLE OF A UNIFIED SCIENCE 20 COURSE

Unifying Science 20: Sample Themes 2 provides an example of a more complex unified course of study. This particular course would be most suited to confident, advanced Science 20 students enrolled in a nonsemestered course system. Three themes are featured. Each theme has a compare/contrast pattern where students would be expected, through cooperative learning, field trips, debates, and exploration of issues, to probe deeply into contemporary topics. Extensive group work is required; for example, during the theme "Two Occupations", students would form groups and make presentations on the knowledge required by two engineers working aboard a space station in the year 2026. These presentations would reflect the knowledge students have acquired to date, plus research on topics related to the occupation studied. The three themes illustrated suggest many opportunities for flexible pedagogy. Out-of-class research through visits to a mining facility, local farm or the slopes of Mt. Brewster, are possible. During the theme "Two Industries"—coal and grain—teachers could explore with students the significance between sustainable and nonsustainable industries, the ecological impact of both industries in Alberta, and organize a debate around the future of coal mining or grain farming in Alberta. This theme also suggests a possible seminar with a social studies class on the history of mining and farming in Alberta.

SAMPLE UNIFIED SCIENCE 20 COURSE OUTLINE

A course outline based on the three themes presented follows the Summary. Of course, the order of topics and their description is entirely up to the imagination of the teachers and students developing a unified course. The outline provided here is simply a sample of what one might be like.

UNIFYING SCIENCE 20: SAMPLE THEMES 2

How a Mountain Forms

Plate tectonics, continental drift, earthquakes, seismology, rock types

When a Mountain Explodes

Case study of Mt. St. Helens: plate tectonics, ecosystem adaptations after the Mt. St. Helens eruption

Two Mountains

Mt. St. Helens, Washington
Mt. Brewster, Alberta

A Mountain as an Ecosystem

Biogeochemical cycles, trophic levels, characteristics of mountain ecosystems, change in ecosystems over time; field trip to Mt. Brewster

The Development of Coal and Grain

Paleontology, formation of coal beds, evolution of grain, ice ages
Integration with social studies: history of mining and farming in Alberta

Ecological Impact of Mining Coal and Growing Grain

Change in ecosystems due to artificial disturbance, carbon cycle and greenhouse effect, precipitation trends
Debate: the future of coal and grain industries in Alberta

Two Industries

Mining Coal and Growing Grain

Technology in the Coal and Grain Industries

Chemistry of hydrocarbons and coal products, chemistry of fertilizer production and use
Option: technology of mining coal and/or technology of planting and harvesting

2026: Space Station *Prospectus Nova*

STS Issue: Should an international space station be established?

Ecosystem Engineer

Responsible for: maintenance of space station ecosystem dynamics, emergency battery back-up systems.
Topics: cycles of matter and energy in ecosystems, testing environmental purity (acid/base), battery design and applications, environmental chemistry

Two Occupations

Terri: Chief Aerospace Engineer
Daniel: Chief Ecosystem Engineer

Aerospace Engineer

Responsible for: all harbour activities and orbit of space station.
Topics: laws of motion, momentum, acceleration/deceleration, gravitational attraction, collision dynamics (how to avoid)

SUMMARY: DEVELOPING A UNIFIED APPROACH TO SCIENCE 20

Developing a unified science course is very demanding. It requires teacher ingenuity, detailed planning, and a group of students who are not dependent on the sequential use of a textbook. Teachers find, however, the challenge of unifying science courses to be quite satisfying. In schools where unified science courses have been developed there is evidence to indicate that:

- there is an increased elective enrollment in science
- a greater proportion of students going to post-secondary study choose science as a major than with a strict disciplines approach to science
- students' marks are at least as good as those of their peers who choose discipline-oriented science courses
- students develop high levels of scientific literacy when exposed to unified science.

These results provide an invitation for science teachers to explore the possibilities of developing unified science courses in their schools.

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SCIENCE 20 COURSE OUTLINE

Introduction

What would it be like to work aboard a space station? How has coal mining affected Alberta ecosystems? Why are some mountains active volcanoes? Will Alberta have a major earthquake? Asking questions is an important part of the human activity we call science. Investigating natural events, studying patterns, comparing and contrasting information, and designing and performing experiments are some of the ways answers to questions posed in science can be found. Our search for answers, and new questions to explore in Science 20, is organized around three themes. Each theme compares and contrasts two subjects in the context of mountains, industries and occupations. These themes interweave in Science 20 to help develop a deeper understanding of our world, the relationships between science and society, and possibilities for the future.

Theme 1: Two Mountains

Mt. St. Helens in the state of Washington, U.S.A. and Mt. Brewster, Alberta, are part of the Cordilleran, orogenic chain of mountains that extend from the Yukon, through British Columbia and Alberta, and into central Washington state. Both mountains are nearly the same in height, yet Mt. St. Helens is famous as an active volcano, while Mt. Brewster is not volcanic. Why are these two mountains so different? The "Two Mountains" theme compares and contrasts the geology and ecology of these mountains, investigates the progress made in science toward predicting volcanic activity, and discovers how science and technology work together to solve questions and save lives.

- How a Mountain Forms
  - Slipping and sliding: the theory of plate tectonics
  - How continents get the drift
  - Predicting the shakes: the science of seismology
  - The Earth has wrinkles, too: how mountains form
  - The original rock and roll

- A Mountain as an Ecosystem
  - Recycling is not new: biogeochemical cycles on the slopes of a mountain
  - Life and death on the mountain side: predator–prey relationships
  - Mountains as ecological systems
  - Researching ecosystems: field trip to Mt. Brewster

- When a Mountain Explodes: A Case Study of Mt. St. Helens
  - Why do some mountains become volcanoes?
  - Dilemmas and difficulties in predicting when a volcano will explode
  - Ecosystems before and after the Mt. St. Helens explosion
  - What does a volcanic explosion teach us?

Theme 2: Two Industries

Tremendous effort and money is expended mining coal and growing grain in Alberta. In this theme, classmates work together to prepare presentations on the practices, problems and potential future of each industry. The use of technology to mine coal and grow grain is explored, and the future industrial development of sustainable and nonsustainable resources will be debated.

- The Development of Coal and Grain
    - Death gives warmth: the formation of coal deposits in Alberta
    - Where did grain come from? Paleontology and the evolution of grain
    - The big chill: the role of the ice ages in the evolution of grain
    - Joint science/social studies class projects: the history of mining and farming in Alberta
- Technology in the Coal and Grain Industries
    - Fuelling interest: the wonderful world of coal and hydrocarbon products
    - Grain can grow on you: the fertilizer industry
    - Machines to move products: mechanical technology in coal and grain production
- Ecological Impact of Mining Coal and Growing Grain
    - Which has greater ecological impact: coal mines or grain farms? Changes in ecosystems due to artificial disturbance
    - The "greenhouse effect" and fossil fuels: are we burning our future?
    - Debate topic: investment, development, and the future of the coal and grain industries in Alberta

Theme 3: Two Occupations

It's been an incredible day aboard the international space station Prospectus Nova. First, you found out that you have been promoted. Then, to your great surprise, you discover a classmate from your old high school on Earth is coming aboard the space station as a chief engineer. In this theme, you will work with your classmates to explore some of the science and technology ideas required for the two occupations. This theme concludes with a formal debate on whether or not an international space station should be established.

- Chief Aerospace Engineer

  This occupation requires you to oversee all operations dealing with maintaining the rotating Prospectus Nova in geostationary orbit. As chief aerospace engineer, you are also responsible for all space station harbour activities, such as docking and launching of vessels from Earth. Some of the knowledge required by your position might be:
  - laws of linear and circular motion
  - understanding momentum
  - calculating acceleration and deceleration
  - determining how to avoid collisions.

- Chief Ecosystem Engineer

  The chief ecosystem engineer is responsible for maintenance of the entire space station ecosystem, including overseeing all daily tests required to monitor ecosystem operation. This chief engineer is also required to ensure that all the emergency battery power back-up system is completely charged and operational in the event of electrical power failure in the space station. Some of the knowledge needed might be:
  - dynamics of artificial ecosystems
  - methods for testing acid/base levels in a space station environment
  - redox reactions and battery integrity.

- Issue: Should an international space station be built?

EXEMPLARS

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EARTHQUAKES

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Science 20 course of studies.

Program General Learner Expectations

The **themes** emphasized are *change* and *diversity.*

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- identifying and clearly stating the problem or issue to be investigated
- differentiating between relevant and irrelevant data or information

Collecting and Recording

- carrying out the procedure and modifying, if necessary
- organizing and correctly using apparatus and materials to collect reliable experimental data

Organizing and Communicating

- communicating findings of investigations in a clearly written report

Analyzing

- identifying assumptions, attributes, biases, claims or reasons
- identifying main ideas

Connecting, Synthesizing and Integrating

- identifying further problems or issues to be investigated
- identifying alternatives for consideration
- proposing and explaining interpretations or conclusions

Evaluating the Processes or Outcomes

- considering consequences and perspectives
- identifying limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used

The **STS connections** emphasized are:

- the functioning of products or processes based on scientific principles
- the ways in which science advances technology and technology advances science

Course General Learner Expectations

Knowledge

- describe, by citing both direct and indirect evidence, how ongoing changes in Earth's crust are explained by the theory of plate tectonics, and how ongoing changes in the biosphere are explained by paleontology

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which science and technology advance one another, using appropriate and relevant examples

Major Concept 1

Forces within Earth cause continual changes on Earth's surface.

Specific Learner Expectations

Knowledge

- explaining how the energy from earthquakes is transmitted by seismic waves
- explaining that seismic waves can be:
    - longitudinal—particles vibrate parallel to the direction of propagation
    - transverse—particles vibrate perpendicular to the direction of propagation

Skills

- demonstrating the difference between primary and secondary earthquake waves, with the use of a flexible coil
- reporting the findings of investigations in a clearly written report

STS Connections

- describing a recent earthquake in terms of plate tectonics theory, the technology used to measure the magnitude and location of earthquakes, and the limitations of current methods used to predict earthquakes

Introduction

Show students a magazine/newspaper clipping or a TV newsclip about a recent earthquake. Raise the questions:

- How do earthquakes cause so much damage?
- Is it possible to design an earthquake-proof building?
- How is the epicentre of an earthquake determined?
- How is the magnitude of an earthquake determined?

Experiential Exploration

Students investigate the transmission of energy by waves by doing Activity 1.1, Investigating Wave Motion, from the *Visions 2* text.

Hypothesis-building

Focused discussion of the velocity of waves, and the characteristics of longitudinal and transverse waves.

Focused discussion of the motion of S and P waves out from the epicentre of an earthquake.

Elaboration

- Simulating Surface Motion: Activity 1.4, *Visions 2*. In this activity, students use foam blocks, felt markers, acetate film and overhead markers to show the effect of earthquake waves on land and buildings.

Application

Cooperative learning groups study:

- the design and construction of earthquake-resistant buildings
- the design and operation of seismographs
- the use of seismic data to locate the epicentre of an earthquake
- the basis of the Richter Scale.

Significance

A knowledge of the characteristics of seismic waves enables explanation of: the destructive force of earthquakes, the characteristics of earthquake-resistant buildings, the basis of the Richter Scale.

Evaluation

Rating scale to evaluate cooperative learning assignment.

BIOGEOCHEMICAL CYCLES AND THE CARBON CYCLE

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Science 20 course of studies.

Program General Learner Expectations

The **themes** emphasized are *change, energy, matter* and *systems*.

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- identifying and clearly stating the problem or issue to be investigated
- differentiating between relevant and irrelevant data or information
- assembling and recording background information
- formulating questions, hypotheses and/or predictions to guide research
- designing and/or describing a plan for research, or to solve a problem
- preparing required observation charts or diagrams

Collecting and Recording

- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating

- organizing and presenting data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
- communicating findings of investigations in a clearly written report

Analyzing

- analyzing data or information for trends, patterns, relationships, reliability and accuracy
- identifying assumptions, attributes, biases, claims or reasons
- identifying main ideas

Connecting, Synthesizing and Integrating

- predicting from data or information
- formulating further testable hypotheses supported by the knowledge and understanding generated
- identifying alternatives for consideration
- proposing and explaining interpretations or conclusions

Evaluating the Process or Outcomes

- considering consequences and perspectives

The **STS connections** emphasized are:

- the central role of experimental evidence in the accumulation of knowledge, and the way in which proposed theories may be supported, modified or refuted
- the inability of science to provide complete answers to all questions
- the ways in which science advances technology and technology advances science
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations

Course General Learner Expectations

Knowledge

- explain how energy and matter are transferred in physical and biogeochemical changes and cycles; and predict energy transfer and movement of matter on the Earth's surface, between components in ecosystems, and in electrochemical systems

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models

STS Connections

- apply cause and effect reasoning to formulate simple relationships for a given instance in which scientific evidence shapes or refutes a theory; and describe the limitations of science and technology in answering all questions and solving all problems, using appropriate and relevant examples

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which science and technology advance one another, using appropriate and relevant examples

- explain for a given instance how science and technology are influenced and supported by society, and the responsibility of society, through science and technology, to protect the environment and use natural resources wisely

Major Concept 1

Matter cycles through the biosphere.

Specific Learner Expectations

Knowledge

- outlining the biogeochemical cycles of carbon, oxygen and nitrogen

Skills

- formulating hypotheses on how alterations in the carbon cycle, as a result of the burning of fossil fuels, might influence other cycling phenomena, and suggesting how the hypotheses could be tested

STS Connections

- drawing parallels between the processes of materials recycling programs in their community and biogeochemical cycles in nature
- analyzing the greenhouse effect in terms of the biogeochemical cycling of carbon, and the limitations of science and technology in providing complete answers to all questions
- evaluating the influence and needs of society, and the impact of a variety of technologies, on the biogeochemical cycle of nitrogen

Introduction

Introduce the students to biogeochemical cycles with a class discussion about the necessity of driving their cars to school. Focus the discussion on fossil fuels, a diminishing resource, and the carbon cycle, as well as automobile emissions and the nitrogen cycle.

OR

Show a film or video on recycling programs, followed by research on the composition of landfill site material with the focus on carbon, oxygen and nitrogen cycles. Have the students research and prepare a chart or graph (leave this open-ended) about the relative amounts of each of the categories of material present in the landfill sites.

Experiential Exploration

Have students work in small groups to research comparisons of humans and automobiles in terms of oxygen consumed, carbon dioxide produced, and nitrogenous waste produced over a set period of time. The teacher or teacher–librarian could help by providing some of the necessary background data. The information could be presented in a variety of ways (open-ended).

OR

Have each of the students categorize the types and amounts, preferably quantitative, of material (garbage) that their own household sends to the landfill over a three- to four-day period. Show individual results of this as a table, chart or graph.

Hypothesis-building

Based on previous learning and activities, use a class discussion to help students come to an understanding that:

- carbon and nitrogen can come from a variety of natural, societal and industrial sources
- disruptions to the natural cycles of carbon and oxygen may be caused by human activities
- serious disruptions of natural cycles can have global consequences (greenhouse effect).

Through a directed class discussion, help students come to an understanding that:

- there are parallels in how nutrients are cycled in natural systems and how society attempts to recycle matter
- there is a very close relationship between nutrient cycles and the activities of plants and animals.

Elaboration

Based on previous learning and activities, use an activity with class discussion to help students extend their understanding of key concepts and practise desired skills and problem-solving strategies by:

- designing and performing an experiment with a closed aquatic system that contains appropriate autotrophs and heterotrophs; measuring, qualitatively and quantitatively, changes in the nitrogen cycle; e.g., ammonia nitrates and nitrites from the initial setup of the system until the system reaches equilibrium.

Application

Show a video on one of the topics below, with a focus on the carbon/oxygen cycle:

- problems of municipal garbage disposal
- the greenhouse effect
- rain forest destruction.

With students in groups, research a number of common products to uncover the hidden costs to the environment—how the production of the product affects the carbon/oxygen cycle directly or indirectly.

Significance

Students could do a risk benefit analysis of the different forms of power generation.

Have students design posters to help explain to the public how their own personal activities affect the carbon/oxygen cycle, and how individuals and communities can change their behaviour to help the environment.

Evaluation

- Tests, Quizzes and Exercises
  - knowledge quizzes on components of the biogeochemical cycles of carbon, oxygen and nitrogen
  - draw/describe/explain the biogeochemical cycles
  - have students explain some aspect of composting/recycling
  - worksheets for review

- Activities
  - written reports on each of the activities
  - observe students (checklists)
  - mark models/charts/assignments
  - mark single aspects of activities
  - peer evaluation

- Investigations
  - written reports on fossil fuel consumption, fertilizer use, or the greenhouse effect
  - oral report on a related concept
  - critique on a news article
  - written report/essay

INVESTIGATING POLYMERS

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Science 20 course of studies.

Program General Learner Expectations

The **themes** emphasized are *change, energy* and *matter*.

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- designing and/or describing a plan for research, or to solve a problem

Collecting and Recording

- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating

- communicating findings of investigations in a clearly written report

Analyzing

- analyzing data or information for trends, patterns and relationships

Connecting, Synthesizing and Integrating

- identifying further problems or issues to be investigated
- identifying alternatives for consideration
- proposing and explaining interpretations or conclusions

Evaluating the Process or Outcomes

- evaluating and assessing ideas, information and alternatives

The **STS connections** emphasized are:

- the functioning of products or processes based on scientific principles
- the limitations of scientific knowledge and technology
- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations

Course General Learner Expectations

Knowledge

- name and provide structural formulas for common hydrocarbons; and classify important hydrocarbon reactions used to produce commercial and petrochemical products

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which science and technology advance one another, using appropriate and relevant examples
- explain for a given instance how science and technology are influenced and supported by society, and the responsibility of society, through science and technology, to protect the environment and use natural resources wisely
- identify subject-related careers and apply the skills and knowledge acquired in Science 20 to everyday life and to related and new concepts in subsequent studies of science.

Major Concept 4

Hydrocarbons are the starting substances for many organic compounds.

Specific Learner Expectations

Knowledge

- classifying the important reactions of hydrocarbons, such as combustion, addition, substitution and polymerization
- describing and naming some important petrochemicals produced from hydrocarbons

Skills

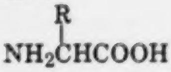
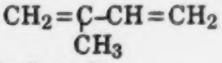
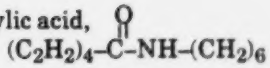
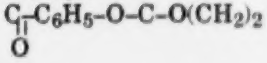
- investigating the physical and chemical properties of hydrocarbons and other selected organic compounds, using safe substances and procedures

STS Connections

- providing examples of hydrocarbons and petrochemicals used on a daily basis in terms of their impact on the quality of life
- describing the ethylene industry in Alberta in terms of the scientific and technological principles applied

Introduction

Prepare a display of natural and synthetic polymers.

Product	Polymer (natural)	Monomer (repeating units)
corn starch, laundry starch	starch	glucose, $C_6H_{12}O_6$
paper, wood, cotton	cellulose	glucose, $C_6H_{12}O_6$
lean meat, beans	protein	amino acids,  $NH_2\overset{R}{\overset{\vert}{C}}HCOOH$
DNA, RNA (use models from biology lab)	nucleic acids	nucleotides (a sugar, a phosphate, a nitrogenous base)
latex gloves, surgical tubing, golf balls	natural rubber	isoprene,  $CH_2=\underset{CH_3}{C}-CH=CH_2$ or 2–methylbutadiene
	Polymer (synthetic)	
plastic toys, containers; e.g., ice cream pails	polyethylene	ethene, $CH_2=CH_2$
styrofoam cups	polystyrene	styrene, $C_6H_5-CH=CH_2$ or vinyl benzene
plumbing pipe, credit cards	polyvinyl chloride (PVC)	vinyl chloride, $CH_2=CHCl$ or chloroethene
windbreaker jackets, nylon stockings	polyamide; e.g., nylon	diamine + dicarboxylic acid,  $(C_2H_2)_4-\overset{O}{\overset{\Vert}{C}}-NH-(CH_2)_6$
thread, fabric, carpet	polyester; e.g., Dacron	ethylene glycol + dicarboxylic acid  $\underset{O}{\underset{\Vert}{C}}-C_6H_5-O-C-O(CH_2)_2$ or 1, 2–dihydroxyethane
bearings, pan coatings	teflon	tetrafluoroethene, $CF_2=CF_2$

Experiential Exploration

Have students use kits or materials at hand, such as toothpicks and jelly candies to build models for some of the simpler monomers, then come together as a group and try to join them into polymers. Models of chains made of paper clips or plastic beads can be used to demonstrate the length and the concept of cross-linking between chains.

Other activities that may be appropriate, depending on availability of materials, are:

- a demonstration of making nylon from adipic acid and hexamethylenediamine:
  - pour 25 mL of a 5% solution of hexanediol chloride in 1, 1, 1–trichloroethane into a 250 mL beaker
  - slowly pour in 25 mL of a 5% aqueous solution of 1, 6–diaminohexane
  - use forceps to pull out nylon fibre from the interface between the two solutions
  - wrap it around a glass rod and wind slowly.

  Precaution: These solutions are not friendly to your skin or the environment. Wear gloves and goggles and store the leftovers for special waste disposal. The nylon fibre is safe to handle once it is washed.
- making "slime" from polyvinyl alcohol and sodium borate (borax):
  - dissolve 2 g of polyvinyl alcohol in 100 mL of water by stirring and heating gently. Cool and add one drop of food colouring
  - add 2 g of sodium borate and stir rapidly.

  Note: No special precautions need to be taken when handling slime. It is nontoxic.

Hypothesis-building

Discuss with students the differing properties of polymers and the relationship of properties to structure, for example:

Why are some polymers stretchy?—The chains form into loops somewhat like a telephone cord.
Why are some polymers hard and others flexible?—The hard ones have numerous cross–links between the chains while the flexible ones do not.
Why do some plastics melt when heated, while others don't?—Thermoplastics have separate chains and soften when heated, while thermosets do not as their structure consists of a web of chains.

A discussion of the difference in biodegradability between natural and synthetic polymers can lead to the issue of plastics accumulating in the environment and some of the ways societies have tried to address this, for example:

- incineration (Europe)
- recycling (Edmonton's Blue Box program)
- increasing biodegradability; e.g., using starch as a filler in garbage bags, developing "natural" plastics produced by microorganisms.

Elaboration

Compare the properties of plastics using Activity 9.3 from *Visions 2*.

Have students practise writing reactions for addition and condensation polymerization. Have them analyze given structural formulas for polymers to try and identify the repeating units (monomers).

Application

Investigate the effect of simulated "acid rain" on nylon stockings and other plastics using a dilute solution of sulfuric acid (0.001 mol/L).

Investigate careers related to the plastics industry.

Significance

Investigate the production of polyethylene in Alberta, in terms of:

- source of ethane—extracted from natural gas at gas processing plants
- ethane conversion to ethene—ethane is shipped in liquid form to conversion plants where it is further purified and converted into ethene, using a cracking process
- polymerization of ethene—a process requiring heat, pressure and a catalyst is used to manufacture polyethylene
- contribution to the economy—major export from Canada.

For further information on the polymerization process, write directly to the following companies:

Dow Chemical Canada Inc.
Western Canada Division
P.O. Bag 16
Fort Saskatchewan, Alberta
T8L 2P4

Novacor Chemicals Ltd.
P.O. Box 5006
Red Deer, Alberta
T4N 6A1

Union Carbide Chemicals and Plastics Canada Inc.
P.O. Box 5501
Red Deer, Alberta
T5N 6N1

AT Plastics Inc.
Box 428
Edmonton, Alberta
T5J 2K1

The following booklet contains information on the ethylene industry in Alberta:

Frank Jenkins et al., *Ethylene and Its Derivatives*, Edmonton, AB: J. M. LeBel Enterprises, 1979. [part of the Alchem Series]

Evaluation

Tests, quizzes and exercises should focus on the students' abilities to recognize and define polymers, describe their properties, and to write reactions for simple polymerizations. Students are also expected to know some general information about the production of ethylene and polyethylene in Alberta.

Activities should be evaluated as suited to classroom circumstances.

As a follow-up to the discussion in the Hypothesis-building section, a short essay could be assigned on the topic of the accumulation of plastics in the environment, asking students to define the problems and propose some solutions.

Have students write letters to companies involved in the ethylene industry asking for information on their process and related careers. Evaluate for clear communication, appropriate language, etc. Send the best ones.

THE RELATIONSHIP AMONG ACCELERATION, DISPLACEMENT, VELOCITY AND TIME

This exemplar addresses the following ***Program*** and ***Course*** **General Learner Expectations** and the **Specific Learner Expectations** from the Science 20 course of studies.

Program General Learner Expectations

The **theme** emphasized is *change.*

The aspects of the **skills framework** emphasized are:

Initiating and Planning

- identifying and clearly stating the problem or issue to be investigated
- differentiating between relevant and irrelevant data or information
- identifying all variables and controls
- preparing required observation charts or diagrams

Collecting and Recording

- carrying out the procedure and modifying, if necessary
- organizing and correctly using apparatus and materials to collect reliable experimental data
- accurately observing, gathering and recording data or information according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

Organizing and Communicating

- organizing and presenting data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
- communicating data more effectively, using mathematical and statistical calculations, where necessary
- expressing measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
- communicating findings of investigations in a clearly written report

Analyzing

- analyzing data or information for trends, patterns, relationships, reliability and accuracy
- identifying and discussing sources of error and their affect on results
- identifying assumptions, attributes, biases, claims or reasons
- identifying main ideas

The **STS connections** emphasized are:

- the functioning of products or processes based on scientific principles

Course General Learner Expectations

Knowledge

- relate and apply, quantitatively, Newton's laws to linear and circular motion of objects and systems; and apply the principle of conservation of linear momentum to one-dimensional interactions and technologies involving motion

Skills

- perform investigations and tasks of their own and others' design that have a few variables and yield direct or indirect evidence; and provide explanations based upon scientific theories and concepts

- collect, verify and organize data into tables of their own design, and graphs and diagrams of others' design, using written and symbolic forms; and describe findings or relationships, using scientific vocabulary, notation, theories and models

- interpret and analyze data that yield straight-line graphs; and use appropriate SI notation, fundamental and derived units, and formulas; and calculate slopes of, and areas under, straight-line graphs

- use mathematical language of ratio and proportion, simple equations, one-dimensional vector addition and subtraction, gravimetric stoichiometry, and unit analysis to solve single- and multi-step problems; and to communicate scientific relationships and concepts

STS Connections

- describe and explain the design and function of technological solutions to practical problems, using scientific principles; and relate the ways in which science and technology advance one another, using appropriate and relevant examples

- identify subject-related careers and apply the skills and knowledge acquired in Science 20 to everyday life and to related and new concepts in subsequent studies of science.

Major Concept 1

The motion of objects is described in terms of displacement, time, velocity and acceleration.

Specific Learner Expectations

Knowledge

- comparing and contrasting scalar and vector quantities
- comparing and contrasting distance and displacement, and speed and velocity
- defining velocity as a change in displacement during a time interval
- defining acceleration as a change in velocity during a time interval
- explaining uniform motion and uniform accelerated motion problems, using scale diagrams and numerical techniques

Skills

- gathering data necessary to infer the relationships among acceleration, velocity and time
- obtaining new data from straight-line graphs by determining the slope and the area under the "line"
- checking the results of mathematical solutions, using unit analysis

STS Connections

- determining safe lengths for airport runways, and freeway entrance and exit ramps in terms of kinematics concepts

Introduction

Use posters showing merging traffic on a freeway, or an aircraft taking off or landing, to stimulate a discussion of "How does science relate to these scenes?" Have the students make a record of their connections. These records can then be used to delineate the concepts, and their order, to be studied by the class.

Alternative: students research the factors considered by traffic engineers when designing roadways, and relate them to kinematics.

Experiential Exploration

Carry out a series of activities which, using airtables or similar apparatuses, will generate displacement–time data. The activities should involve both uniform motion and uniformly accelerated motion.

Hypothesis-building

Using the empirical data gathered, generate position–time and velocity–time graphs, and in turn, use the graphs to determine velocity, displacement and acceleration. Remind students of the analytical methods that were used to analyze similar, but more restrictive data in Science 10.

Elaboration

Have students perform and evaluate an experiment to determine the local value of the acceleration due to gravity using similar data gathering and analyzing techniques as in the "Experiential Exploration" section.

Application

Have students solve problems, using the concepts of kinematics graphically and algebraically. These problems should be contextualized as much as possible, using the lists of science connections developed in the Introduction.

Significance

Analyze data from a traffic engineering department that demonstrates the application of kinematics to control traffic flow or to roadway design; e.g., off–on ramps.

Analyze the length of an airport runway from a kinematics perspective.

Debate the pros and cons of the amount of land used for roadway intersections.

An assessment of the examples used to introduce this topic may be used to indicate future concepts to be studied in order to examine their design and function; e.g., circular motion.

Evaluation

- Tests, quizzes and exercises
  - use worksheets for practise and review
  - have students, using data provided, plot position–time graphs, velocity–time graphs and interpret the motion depicted by them
  - have students determine velocity, displacement and acceleration

- Activities
  - prepare a written report of the lab exercises
  - peer evaluation of the debate on land use for roadway intersections

- Investigations
  - ask for a written report of the roadway design investigation
  - have students present an oral report of the roadway design investigation

RESOURCES

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RESOURCES

by Desiree Hackman and Pamela Shipstone

The following is a list of resources useful for implementing the Science 20–30 program. This resource list is divided into the following sections:

Science 20 Major Concepts with Resource Listings (by Unit)
Science 30 Major Concepts with Resource Listings (by Unit)
Science 20–30 Basic Student Learning Resources
Science 20–30 Authorized Support/Teaching Resources
Other Learning Resources: General
  Laboratory Interfaces
  Software
  Videodiscs
  Teacher Background
Other Learning Resources: Science 20 (by Unit)
Other Learning Resources: Science 30 (by Unit)
Distributor Addresses (alphabetical)

Basic student learning resources are those student learning resources authorized by Alberta Education as the most appropriate for addressing the majority of learner expectations of the course(s), substantial components of the course(s), or the most appropriate for meeting general learner expectations across two or more grade levels, subject areas or programs as outlined in provincial programs of study. These may include any resource format, such as print, computer software, manipulatives or video.

Authorized teaching resources are those teaching resources produced externally to Alberta Education (for example, by publishers) that have been reviewed by Alberta Education, found to meet the criteria of review and to be the best available resources to support the implementation of programs of study and courses, and the attainment of the goals of education; they have been authorized by the Minister. Teaching resources produced as service documents by Alberta Education, such as the *STS Science Education: Unifying the Goals of Science Education* monograph, and diagnostic programs, are authorized by definition.

Support student learning resources are those student learning resources authorized by Alberta Education to assist in addressing some of the learner expectations of course(s) or components of course(s); or assist in meeting the learner expectations across two or more grade levels, subject areas, or programs as outlined in the provincial programs of study. They may include any resource format, such as print, computer software, manipulatives or video.

Other learning resources are those learning resources identified by Alberta Education as useful for teachers in the implementation of a course(s) or program(s) of studies, but which have not undergone review procedures by Alberta Education. Alberta Education does not accept responsibility for use of these resources with students. It is the responsibility of the teacher to determine their suitability and application.

When searching for resources to support the science program you may want to check:

- Other departments within your school. Often, resources are useful for ideas in more than one subject area. For example, Junior High Science, Environmental and Outdoor Education (EOE), Social Studies, Career and Life Management (CALM), or English.
- School library for print or nonprint resources.
- ACCESS Network for many authorized teaching and support video resources.
- LRDC for most authorized teaching and support print resources and some nonprint resources.
- Government and nongovernment agencies for print and nonprint educational materials and/or background information.
- Distributor for print and nonprint resources.

Basic student learning resources are available through the Learning Resources Distributing Centre (LRDC). A *Buyers Guide* is also available.

Learning Resources Distributing Centre
12360 - 142 Street
Edmonton, Alberta
T5L 4X9
Telephone (403) 427-2767

Note: The information included was the most recent information available at the time this document was prepared. Prices of resources were listed as provided by distributors, May 1993. Check with distributor for current rates.

UNIT 1: THE CHANGING EARTH

A – Authorized Section
O – Other Section by Unit:
- Science 20
- Science 30

★ – Nonprint
● – Print

1. Forces within Earth cause continual changes on Earth's surface.

O●Earth and Atmosphere: Pathways Through Science Series
O★Earth Revealed Series
O●Earthquakes
O★Earthquakes
O★Living Machine (The): Continental Tectonics and the Earth's Interior: Planet Earth Series
O★Living Machine (The): Plate Tectonics: Planet Earth Series
A★Moving Mountains: Senior High Science Video Series
O★North Sea 1: The Tectonic Framework: Sedimentary Processes and Basin Analysis Series
O★Plate Tectonics
O★Plate Tectonics: The Earth Explored Series
O★Plate Tectonics: The Puzzle of the Continents
O★Restless Earth (The): Understanding the Theory of Plate Tectonics
O★Restless Rocks: Spaceship Earth Series
O★Sea-floor Spreading
O★Seismic Reflection Processing: Sedimentary Processes and Basin Analysis Series
O★Seismic Stratigraphy: Sedimentary Processes and Basin Analysis Series

2. Paleontology, the scientific study of ancient life, uses fossils as the primary source of data.

O★Dinosaur Footprints of the Peace River Valley
A★Dinosaurs: The Ageless Quarry
O★Dinosaurs: The Nature of Things Series
O★Dinosaurs and Their Descendants: Life on Earth Series
O●Earth and Atmosphere: Pathways Through Science Series
O★Earth Has a History
O★Flesh on the Bones: Dinosaur Series
O★Form and Function of Fossils: The Earth Explored Series
A★Oxygen Partnership: Planet Under Pressure Series
O●Paleoguide: A Teacher's Guide to Paleontology
O★Setting the Stage: Bow Summit Edukit

3. The fossil record indicates that the environment and life forms on Earth have undergone a sequence of changes over more than 3.5 billion years.

O●Alberta: A Natural History
O★Burgess Shale: Impressions of Life: The Nature of Things Series
O★Darwin, Naturally: Organic Evolution Series
O●Development of Natural Gas in a Northern Community (The)
O●Earth and Atmosphere: Pathways Through Science Series
O●Earth Science for Every Kid: 101 Easy Experiments That Really Work
O●Earth Science: 49 Science Fair Projects: Science Fair Projects Series
O★Form and Function of Fossils: The Earth Explored Series
O★Gifts from the Earth: Energy Resources: Planet Earth Series
O★In the Beginning: Organic Evolution Series
O★Natural Connections: The Nature of Things Series
A★Natural Selection
O★North Sea 2: The Origin and Migration of Hydrocarbons: Sedimentary Processes and Basin Analysis Series
O●Oil Sands Interpretive Centre
O★Origins of Change: DNA and the Evidence for Evolution: The Evolution Series
O●Our Petroleum Frontiers: Environmental Issues
O●Our Petroleum Resources: Environmental Issues
O★Patterns of Diversity: Genetics Series
O★Seismic Reflection Processing: Sedimentary Processes and Basin Analysis Series
O★Seismic Stratigraphy: Sedimentary Processes and Basin Analysis Series
O●Somebody Should Do Something About This

4. The geologic record indicates that huge glaciers have formed in Arctic regions and flowed south over large areas of Canada several times over the last two million years.

O★Blue Planet (The): Circulation of the Oceans: Planet Earth Series
O★Blue Planet (The): Physical and Chemical Makeup of the Oceans: Planet Earth Series
O●Climate Change Digest: Exploring the Implications of Climate Change for the Boreal Forest and Forestry Economics of Western Canada
O★Climate Puzzle: Climates—Past, Present and Future: Planet Earth Series
A★Comfort Blanket (The): Planet Under Pressure Series
O●Development of Natural Gas in a Northern Community (The)
O★Earth Revealed Series
O★Gaia: Goddess of the Earth
O★Glaciers
O★Greenhouse
O★Greenhouse Effect . . . To What Degree?
O★Habitat Turned Hothouse (A): Icewalk Series
O●Impacts of Global Warming (The)
O★Precious Envelope (The): The World of Chemistry Series
A★Winds of Change: Planet Under Pressure Series

UNIT 2: CHANGES IN LIVING SYSTEMS

A – Authorized Section
O – Other Section by Unit:
  - Science 20
  - Science 30
★ – Nonprint
● – Print

1. Matter cycles through the biosphere.

O●Biosphere (The): Science Now Series
O★Can Polar Bears Tread Water?
O★Circles and Cycles: Aspects of Ecology Series
O●Development of Natural Gas in a Northern Community (The)
O●Environment: Pathways Through Science Series
O★Fate of the Earth (Part 1): Geochemical Cycles: Planet Earth Series
O★Forestry Biotechnology: Women in Science Series
A★Great Expectations: Recycling in Alberta
O★Greenhouse
O●Home Composting: How to Build and Maintain a Compost Bin
O★Nuclear Waste Management: Science Screen Report Series
O●Recycling in Canada
O●Reduction and Reuse: The First 2 R's of Waste Management
O●Taking Action Through Backyard Composting to Reduce Household Waste
O●Waste Paper Recycling in Canada
A★Water, Water Everywhere: Planet Under Pressure Series
A★Winds of Change: Planet Under Pressure Series

2. Energy flows through the biosphere.

A●★Aquatic Invertebrate Monitoring Program
O●Development of Natural Gas in a Northern Community (The)
A★Effects of Water Pollution (The): The Fragile Planet Series
O★Energy Balance (The)
O●Environment: Pathways Through Science Series
O●Pesticide Education Program
O●Recognizing Herbicide Action and Injury

3. Ecosystems are defined by a range of characteristics.

O★Anatomy of an Oil Spill
A●★Aquatic Invertebrate Monitoring Program
O★Climate for Growth (A): Bow Summit Edukit
A●Ecology Studies of Lakes in Alberta: Water Literacy Series
O★Ecosystems: Aspects of Ecology Series
O●Environment: Pathways Through Science Series
O★Into Deep Water: Turning the Tide Series
A●Natural Regions of Alberta—Poster Series
O★Patterns—A Mountain Patchwork: Bow Summit Edukit
O★Shores of Life (The)
O★Touched by the Tide
A●Water Quality Questions: The Nature and Importance of Water Quality Variables in Alberta
O●Weeds of the Prairie
A★Water, Water Everywhere: Planet Under Pressure Series
O●Wetlands in Canada: A Valuable Resource

4. Ecosystems often change over time.

O★And Then Came People: Bow Summit Edukit
A●★Aquatic Invertebrate Monitoring Program
O★Biomes: Aspects of Ecology Series
O★Biomes: Coniferous Forest
O★Biomes: Desert
O★Biomes: Grassland
O★Biomes: Introduction
O★Biomes: Tropical Rain Forest
O★Biomes: Tundra
O●Environment: Pathways Through Science Series

5. Organisms are adapted to their environments.

O★Adaptations—A Struggle for Survival: Bow Summit Edukit
O●Environment: Pathways Through Science Series
A★Life Science: Principles of Biology: The Living Textbook Series
O★Populations: Aspects of Ecology Series

UNIT 3: CHEMICAL CHANGES

A – Authorized Section
O – Other Section by Unit:
- Science 20
- Science 30

★ – Nonprint
● – Print

1. Aqueous solutions provide a convenient medium for chemical changes.

A★Acids and Bases: World of Chemistry Series
O★Chemistry of the Earth: World of Chemistry Series
O●Development of Natural Gas in a Northern Community (The)
A★Dynamic Equilibrium: Chemical Equilibrium Series
O●Making Materials: Pathways Through Science Series
O●Materials: Pathways Through Science Series
O●Pesticide Education Program
A★Physical Science: Cosmic Chemistry: The Living Textbook Series
A★Water, Water Everywhere: Planet Under Pressure Series

2. Balanced chemical equations show the quantitative relationships among the reactants and products involved in chemical reactions.

A★Dynamic Equilibrium: Chemical Equilibrium Series
O●Making Materials: Pathways Through Science Series
O●Materials: Pathways Through Science Series
A★Physical Science: Cosmic Chemistry: The Living Textbook Series

3. Oxidation and reduction reactions are an example of chemical change involving energy.

A★Building Blocks of Electrochemistry (The): Electrochemistry Series
A★Commercial Electrochemical Cells: Electrochemistry Series
A★Corrosion: Electrochemistry Series
A★Designing Electrochemical Cells: Electrochemistry Series
A★Electrochemical Cells: Electrochemistry Series
A★Electroplating: Electrochemistry Series
O★Ions and Electrons in Metals: Chemistry: From Theory to Application
O★Oxidation-Reduction: World of Chemistry Series
A★Physical Science: Cosmic Chemistry: The Living Textbook Series

4. Hydrocarbons are the starting substances for many organic compounds.

O★Age of Polymers (The): World of Chemistry Series
O★Anatomy of an Oil Spill
O●Development of Natural Gas in a Northern Community (The)
O●Ethanol Blended with Gasoline
A★Fixing Fuels: Organic Chemistry Series
O★Gifts from the Earth: Energy Resources: Planet Earth Series
O●Making Materials: Pathways Through Science Series
O●Materials: Pathways Through Science Series
O●Our Petroleum Challenge in the 1990s
O★Petroleum: River of Energy
A★Physical Science: Cosmic Chemistry: The Living Textbook Series
O●Pipelines in Canada
A★Polyethylene: Organic Chemistry Series
O●Refined Motor Oil

UNIT 4: CHANGES IN MOTION

A – Authorized Section
O – Other Section by Unit:
- Science 20
- Science 30

★ – Nonprint
● – Print

1. The motion of objects is described in terms of displacement, time, velocity and acceleration.

O★Law of Falling Bodies (The): The Mechanical Universe Series
O★Microgravity: Space Education Series
O★Vectors: The Mechanical Universe Series
O★What If?

2. Newton's laws of motion relate force to the motion of objects.

O★Conservation Laws and Fundamental Forces: The Mechanical Universe Series
O★Force and Motion: Newton's Three Laws
O★Inertia: The Mechanical Universe Series
O★Kinematics and Scientific Methods: The Mechanical Universe Series
A★Newton's First Law
O★Newton's Laws: The Mechanical Universe Series
A★Newton's Third Law
A★Physical Science: Principles of Physical Science: The Living Textbook Series
O★Physics on Earth and in the Heavens: The Mechanical Universe Series

3. An object moving in a circular path, with a constant speed, undergoes an acceleration toward the centre of the circle.

A★Apple and the Moon (The): The Mechanical Universe Series
O★Earth: A Special Case: Planet Under Pressure Series
O★Kepler Problem (The): The Mechanical Universe Series
O★Kepler's Three Laws: The Mechanical Universe Series
O★Kinematics and Scientific Methods: The Mechanical Universe Series
O★Moving in Circles: The Mechanical Universe Series
A★Physical Science: Principles of Physical Science: The Living Textbook Series
A★Physics: Cinema Classics
O★Physics on Earth and in the Heavens: The Mechanical Universe Series

4. Momentum is conserved in physical interactions.

O★Angular Momentum: The Mechanical Universe Series
O★Conservation Laws and Fundamental Forces: The Mechanical Universe Series
O★Conservation of Momentum: The Mechanical Universe Series
A★Physical Science: Principles of Physical Science: The Living Textbook Series
A★Physics: Cinema Classics

UNIT 1: LIVING SYSTEMS RESPOND TO THEIR ENVIRONMENT

A - Authorized Section
O - Other Section by Unit:
  - Science 20
  - Science 30
★ - Nonprint
● - Print

1. The circulatory system enables the human body to interact with its environment.

O★Circulation of the Blood (Canadian Learning Company)
O★Circulation of the Blood (Marlin Motion Pictures Ltd.)
A★Life Science: Principles of Biology: The Living Textbook Series
O★Life Under Pressure
O●★Stratagem: Modelling Sustainable Development

2. The human body has defence mechanisms to protect itself from disease-causing organisms and adverse environments.

O★Immune System (The): Science Show Series
A★Immune System (The): Your Magic Doctor
A★Life Science: Principles of Biology: The Living Textbook Series
O★Our Immune System: The Human Body Series
O★Susumu Tonegawa: Keys to the Immune System: Nobel Prize Series
O★Transplant Immunology: Women in Science Series

3. The nervous system mediates the interaction of humans with their environment.

A★Life Science: Principles of Biology: The Living Textbook Series
O★Nervous System: The Human Body Series

4. Some human diseases are inherited.

O★Amish (The): Genetics Series
O★Amniocentesis for Prenatal Testing
O★Genes and Hereditary Disorders
O★Genetics: Science Show Series
O★Muscular Dystrophy: Race for the Gene
O★Pandora's Box: The Life Revolution Series

UNIT 2: CHEMISTRY IN THE ENVIRONMENT

A – Authorized Section
O – Other Section by Unit:
  • Science 20
  • Science 30
★ – Nonprint
● – Print

1. Chemistry is an essential component of environmental studies.

O★Amazing Vanishing Ozone (The): Icewalk Series
O★Assault on the Ozone Layer: The Fragile Planet Series
O★Black Tide
O★Breath of Fresh Air (A): The Global Environment Series
O●ChemCom: Chemistry in the Community
O●Chemical Survey and Solutions and Pollution
O★Clean Air: Industry, Transportation and Air Pollution: Earthbeat Series
O★Crisis in the Atmosphere: Understanding Global Climate Changes: Infinite Voyage Series
O●Determining Threshold Limits
O★Down in the Dumps: The Global Environment Series
O★Environment: Science Show Series
O★Fit to Drink
O★Fossil Fuels
A★Global Warming: Hot Times Ahead
O★Great Lakes: Troubled Water (Update): The Nature of Things Series
O★Hazardous Waste Management: Alberta's Success Story
O★Household Hazardous Waste Management
O★Howe Sound: Poisoned Waters: The Nature of Things Series
O★Into Deep Water: Turning the Tide Series
O●Investigating Groundwater: The Fruitvale Story
A★Life After Chemistry: Organic Chemistry 2 Series
O★New Alchemy (The): W5 Series
O★Only One Atmosphere: Race to Save the Planet Series
O●Ozone and UV Bulletins
O★Ozone Blanket in the Air: Science Screen Report Series
O★PCBs in the Food Chain
A★Physical Science: Cosmic Chemistry: The Living Textbook Series
O★Royal Flush: W5 Series

2. Acids and bases affect the chemistry of aqueous systems and have important environmental effects.

O★Acid Rain: The Invisible Threat
O●ChemCom: Chemistry in the Community
A★Physical Science: Cosmic Chemistry: The Living Textbook Series
O★Proton in Chemistry (The): The World of Chemistry Series
O★Storm of Acid Snow (The): Icewalk Series

3. Organic compounds can have both positive and negative environmental effects.

O●Alternatives to Pesticides
O●ChemCom: Chemistry in the Community
A★Glues: Organic Chemistry 2 Series
A★Physical Science: Cosmic Chemistry: The Living Textbook Series
O●Toxic Waste: A Teaching Simulation
O★Valley of Heart's Delight: Only One Earth Series
O★What's On Tap?: The Global Environment Series

UNIT 3: ELECTROMAGNETIC ENERGY

A – Authorized Section
O – Other Section by Unit:
- Science 20
- Science 30

★ – Nonprint
● – Print

1. Field theory is one of the most important ideas in modern science.

O★Electromagnetism (Part 1: Electric Fields, EM Fields, Motor Effect)
O●Energy Control and Communication: Pathways Through Science Series
A★Physics: Cinema Classics

2. Field theory can be used to explain the operation of many important electric devices.

O★Electromagnetism (Part 1 Electric Fields, EM Fields, Motor Effect)
O●Energy Control and Communication: Pathways Through Science Series
A★Physical Science: Cosmic Chemistry: The Living Textbook Series
A★Physics: Cinema Classics

3. The electromagnetic spectrum is a continuous range of electromagnetic waves with specific characteristics and similar properties.

O★Communicating at the Speed of Light
O★Electromagnetism (Part 1: Electric Fields, EM Fields, Motor Effect)
A★Fibre Optics
O★Lake That Fell to Earth (The)
O★Lasers: The Science of Light Amplification: Science Screen Report Series
O★Light and the Electromagnetic System: Physical Science II Series
O★Light, Color and the Visible Spectrum: Physical Science Series
A★Physical Science: Cosmic Chemistry: The Living Textbook Series
O★Radar: Vision from Space: The Nature of Things Series
O★Recording and Reproduction Techniques: The Science Show Series

4. The study of the history and structure of the Universe uses the entire electromagnetic spectrum.

O★Lake That Fell to Earth (The)
A★Physical Science: Cosmic Chemistry: The Living Textbook Series

UNIT 4: ENERGY AND THE ENVIRONMENT

A – Authorized Section
O – Other Section by Unit:
- Science 20
- Science 30

★ – Nonprint
● – Print

1. The global demand for energy must be reconciled with the need to maintain a viable biosphere.

O●Conservation Pamphlets
O★Conserve Energy: Alternative Solutions: Earthbeat Series
O●Energy Resources: Pathways Through Science Series
O★Energy for Societies: You, Me and Technology Series
O★Energy: What About Tomorrow?
O★Geothermal Energy: The Earth Explored Series
O●*Guideposts for a Sustainable Future
O★Light and Energy: Science Show Series
O★Primal Furnace: Geothermal Energy

2. The Sun is Earth's main source of energy.

O★Anatomy of an Oil Spill
O●Energy Resources: Pathways Through Science Series
O★Fossil Fuels
A●Home Energy Analysis and Tutorial (Heat) Kit (The)
O★Light Makes Electricity
A★Physical Science: Cosmic Chemistry: The Living Textbook Series
O★Power for the People: The Global Environment
O★Pulp Mills
O★Running Out of Steam: Turning the Tide Series

3. Mass is converted to energy in nuclear reactions.

O★Nuclear Energy
O★Nuclear Power: Fission, Fusion and Their Applications
O★Nuclear Waste Management: Science Screen Report Series

4. The study of the history and structure of the Universe uses the entire electromagnetic spectrum.

O★Lake That Fell to Earth (The)
A★Physical Science: Cosmic Chemistry: The Living Textbook Series

Basic Student Learning Resources

Science 20

Visions 2, 1993

Format	Student Text
Annotation	Customized basic student learning resource for Science 20.
Price	$53.40
Author	Gage Educational Publishing Company
Distributor	LRDC 234500

Visions 2, 1993

Format	Teachers' Guide
Annotation	Complement to *Visions 2* student text for Science 20.
Price	$53.40
Author	Gage Educational Publishing Company
Distributor	LRDC 234518

Science 30

Visions 3, 1994

Format	Student Text
Annotation	Customized basic student learning resource for Science 30. Available June 1, 1994.
Price	TBA
Author	Gage Educational Publishing Company
Distributor	LRDC

Visions 3, 1994

Format	Teachers' Guide
Annotation	Complement to *Visions 3* student text for Science 30. Available June 1, 1994.
Price	TBA
Author	Gage Educational Publishing Company
Distributor	LRDC

Authorized Student Support/Teaching Resources

Acids and Bases: World of Chemistry Series, 1988 — **Science 20, Unit 3**

Format	Video (15 min.)
Annotation	The properties of acids and bases, including neutralization, are shown. The definition of pH is simplified for ease of understanding. Real-world examples are the neutralizing action of antacid tablets and the problem of acid rain. *(Authorized Student Support for Chemistry 20)*
Price	$55 ($450 for series)
Distributor	Magic Lantern Communications Ltd.

Apple and the Moon (The): The Mechanical Universe Series, 1985 — **Science 20, Unit 4**

Format	Video (29 min.)
Annotation	The first authentic steps toward outer space. Seeking an explanation for Kepler's theories, Newton discovered that gravity describes the force between any two particles in the Universe. From an English orchard to Cape Canaveral and beyond, Newton's universal law of gravity reveals why an apple but not the moon falls to the Earth. (*Authorized Student Support for Physics 20*)
Price	Contact LRDC/distributor
Distributor	Magic Lantern Communications Ltd.

Aquatic Invertebrate Monitoring Program, 1991 — **Science 20**

Format	Kit
Annotation	The kit includes a teacher's manual and video. The video discusses Project AIM, methods and techniques and aquatic invertebrates. (*Authorized Teaching Resource*)
Price	$85. Components can be purchased separately.
Distributor	FEESA: An Environmental Education Society

Asimov's Chronology of Science and Discovery, 1989 — **Science 20–30**

Format	Print	ISBN 0060156120
Annotation	From 4 000 000 BCE to the present, the significant events in astronomy, exploration, biology, physics, chemistry and mathematics are described. Asimov illustrates how scientific, cultural, social and political events affected each other. Discoveries and inventions are categorized by year of discovery against a backdrop of world history, and show how science influenced the world and how the world responded to scientific advances. A good source of background information for science teachers. *(Authorized Teaching Resource)*	
Cost	Contact LRDC	
Author	Isaac Asimov	
Distributor	Harper Collins Books of Canada Ltd.	

Athabasca (The): A Case Study: Senior High Science Video Series, 1990 **Science 20**

Format	Video	
Annotation	This program examines the impact that proposed pulp and paper mills would have on the ecology of the Athabasca River, with a focus on a variety of viewpoints. This program supports the proposed biology and science courses, as well as the current Biology 20. (*Authorized Student Support*)	
Price	See ACCESS Network catalogue	
Distributor	ACCESS Network	BPN 302207

Atlas of Environmental Issues, 1989 **Science 20**

Format	Print	ISBN 081602023X
Annotation	Describes and explains major environmental issues of today's world, including soil erosion, deforestation, mechanized agriculture, oil pollution of oceans, acid rain, overfishing and nuclear power. Excellent graphics. (*Authorized Student Support for Environmental and Outdoor Education*)	
Price	$22.88	
Author	Nick Middleton	
Distributor	Facts On File	

Building Blocks of Electrochemistry (The): Electrochemistry Series, 1986 **Science 20, Unit 3**

Format	Video (10 min.)	
Annotation	Basic concepts of electrochemistry are introduced with the aid of a robot powered by an electrochemical cell. The chemical reactions that occur inside the cell demonstrate the principles of reduction and oxidation—the redox reactions—that produce the flow of electrons in the cell. (*Authorized Student Support for Chemistry 30*)	
Price	See ACCESS Network catalogue	
Distributor	ACCESS Network	VC324801

Chemistry of Solutions: Program 12, 1992

Science 20

Format	Video (10 min.)
Annotation	Several solutions and their unique combinations of solutes and solvents are studied. Two teenage hosts conduct lab demonstrations and describe computer animated sequences. (*Authorized Student Support*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network BPN 302212

Commercial Electrochemical Cells: Electrochemistry Series, 1986

Science 20, Unit 3

Format	Video (10 min.)
Annotation	This program demonstrates how chemical reactions studied in previous programs apply to commercially available batteries. The development of the modern battery is traced, highlighting the discoveries of Galvani and Volta, the widely used Leclanché cell, and rechargeable cells. (*Authorized Student Support for Chemistry 30*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC324804

Corrosion: Electrochemistry Series, 1986

Science 20, Unit 3

Format	Video (10 min.)
Annotation	This program is an investigation of the question: Why does rust develop? The oxidation-reduction reaction that produces corrosion is shown, explaining the role of the electrochemical cell. Ways to prevent and control corrosion by galvanization and cathodic protection are illustrated. (*Authorized Student Support for Chemistry 20–30*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC324804

Designing Electrochemical Cells: Electrochemistry Series, 1986 — Science 20, Unit 3

Format	Video (10 min.)
Annotation	This program shows how to build a super electrochemical cell, explaining the need for a standard half-cell, how to predict the direction of the electron flow, and finally, how a table of reduction potentials can predict the output of a cell. (*Authorized Student Support for Chemistry 30*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC324803

Dinosaurs: The Ageless Quarry, 1987 — Science 20

Format	Video (30 min.)
Annotation	Uncovers the ancient world of dinosaurs on a tour through the fossil-rich Badlands of the Red Deer River Valley. Includes interviews with paleontologists from around the world who discuss the renowned Tyrrell Museum of Paleontology in Drumheller, Dinosaur Provincial Park—a UNESCO World Heritage Site—and the Tyrrell Field Station in Brooks. (*Authorized Student Support*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC656501

Dynamic Equilibrium: Chemical Equilibrium Series, 1984 — Science 20, Unit 3

Format	Video (10 min.)
Annotation	By focusing on the behaviour of hydrogen iodide, this program describes how all chemical reactions operate in two directions. It uses a collision model, based on the kinetic molecular theory, to explain how molecules behave to produce dynamic equilibrium. (*Authorized Student Support for Chemistry 30*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC324702

Ecology Series, 1992

Format Video

Annotation

Summary: This series is designed to help viewers grasp ways in which plants and animals are interconnected within their ecosystems. From mountain plateaus to sea bottoms, it introduces a rich variety of ecosystems—identifying communities they contain and the ways that relationships among their members affect each population's growth. (*Authorized Student Support*)

Communities (14 min.)
When several species of sea birds nest on a rocky island, their relationship in the community is shaped by competition for nesting space. In any community—a group of plants and animals of different species living together in the same habitat—there are many relationships among species. This program provides a look at how species interact within a community and helps viewers understand:

- the difference between an open and closed community
- how competition, predation and cooperation can define the relationships among species in a community
- the features of commensal, mutual and parasitic symbiosis.

It also shows several contrasting habitats and the different communities they contain.

Food Chains (14 min.)
This program follows a food chain from undersea kelp forests—the primary producers that collect light energy, transfer it into chemical energy and store it in their tissues—through primary and secondary consumers. Explore a variety of food chains in shallow and deep-water habitats to discover:

- the difference between an ordinary food chain and a detritus food chain
- how food chains can interact in a food web
- what happens in a food web when a keystone species disappears.

This program also describes the chemical reactions of photosynthesis, defines an energy pyramid and takes viewers up a food chain to determine why there are fewer and fewer animals at each link.

Nutrient Cycle (14 min.)
Examine the nutrient cycle—a cycle that moves essential elements from the environment into the bodies of a succession of living things, then back into the environment again—with this instructive program. Provide viewers with a look at the nutrient cycle at work on a mountain plateau, in a rain forest, in a mangrove swamp and in the ocean. Viewers will learn:

- to identify the nutrient cycles of nitrogen, carbon, oxygen and phosphorus
- how essential elements can be locked up for long periods of time in wood and sediment
- that the abundance of life on Earth is made possible by the recycling of essential elements.

This program also leads viewers to consider other, related subjects, including nitrogen fixation.

Populations (14 min.)

Populations—all the members of a species living in the same area at the same time—are continually challenged by internal and external influences. Examine many of the challenges populations struggle with in order to survive, including the environment, biological factors, territoriality and population density. Viewers will discover:

- any population can increase in numbers through reproduction
- there are limits to any population's growth.

Viewers will also learn that human settlements have affected other populations, increasing some while endangering others, and that regulating human influences requires a deep understanding of populations.

Succession (16 min.)

What happens to a habitat when it's disturbed and its old community of plants and animals dies? Succession, a process where life reappears in waves of colonization and regrowth is nature's response to dramatic environmental change. This program provides a fascinating look at succession in action on a barren beach, in an untilled field and in an abandoned urban area and helps viewers to:

- identify several habitat disruptions that can trigger biological succession
- understand how the relative barrenness of disturbed land can change the course of succession.

Viewers also discover that as a habitat is colonized by different plants and animals, it changes, making it possible for new colonists to gain a foothold and create another, often much different, environment.

Price	Contact distributor Single copy (series of 5): $395 Bulk purchase (series of 5): $325 per copy for 50 copies; $200 per copy for 100 copies
Distributor	Magic Lantern Communications Ltd.

Ecology Studies of Lakes in Alberta: Water Literacy Series, 1988 **Science 20, Unit 2**

Format	Print	
Annotation	This handout deals with the ecology of freshwater environments. The human impact on lake environments is introduced, as well as the methods and technology employed to study lakes. Workshops are provided by Alberta Environment. A teacher package, 1989, includes a guide, observation notes and student worksheets. (*Authorized Student Support for Environmental and Outdoor Education*)	
Price	$1.95 (free with workshop from Alberta Environment) Teacher package: $16.20 (free with workshop from Alberta Environment)	
Author	Alberta Environment	
Distributor	LRDC	0EV07024 0EV07023 (teacher package)

Effects of Water Pollution (The): The Fragile Planet Series, 1990 **Science 20, Unit 2**

Format	Video
Annotation	This video addresses the issue of the effects of water pollution on the ecosystem and the food chain. (*Authorized Student Support for Junior High Science*)
Price	$149 U.S. ($749 for series)
Distributor	Films for the Humanities and Sciences

Electrochemical Cells: Electrochemistry Series, 1986 **Science 20, Unit 3**

Format	Video (10 min.)
Annotation	The operation of an electrochemical cell is shown with a laboratory model of a zinc–copper cell. Animation at the atomic level shows that differences in activity levels determine the effectiveness of the electrochemical cell. (*Authorized Student Support for Chemistry 20–30*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC324802

Electromagnetism Series, 1988 — Science 30

Format: Six, 10-minute videos

Annotation:

Summary: Shows how the historic discovery of the magnetic properties of lodestone led to the scientific understanding of the Earth's magnetic field. Examines this mysterious force as it applies to electromagnetic induction, the motor principle, generators and transformers. Looks at fascinating modern theories about the Earth's magnetic field in the extinction of species and about the ways in which animals use it for navigation. (*Authorized Student Support)*

Earth's Magnetic Field VC301201
Provides a chronology of the discoveries made about the properties of lodestone, from the initial discovery that lodestone had a mysterious attraction to iron, to the conclusion that the Earth itself is a huge magnet.

Magnetism and Electron Flow VC301202
Introduces the left-hand rule for predicting the relationship between the direction of the magnetic field and the direction of the electron flow in a conductor. Demonstrates the extended magnetic field surrounding a helix.

Domain Theory VC301203
Examines the electromagnet and illustrates the relative conductivity of various metals at the atomic level. Reviews the left-hand rule. Shows the way that atoms of metals, such as iron and steel, arrange themselves in domains.

The Motor Principle VC301204
Introduces the motor principle by using the analogy of a futuristic magnetic rail gun. Shows current flowing through a simple loop of wire within an external magnetic field, causing the loop to rotate partially. Adds a split-ring commutator to achieve continuous rotation.

Electromagnetic Induction VC301205
Tells how in 1830 British scientist Michael Faraday discovered the principle of electromagnetic induction. Demonstrates this along with Lenz's law that the inducted magnetic field always opposes the changing external magnetic field.

Life in the Field VC301206
Illustrates the effects of Earth's magnetic field on all forms of life. Looks into the theory that many animals become extinct as a result of occasional reversals of Earth's magnetic field. Examines how animals use Earth's magnetic field for navigation.

Price: Contact ACCESS Network

Distributor: ACCESS Network

Electroplating: Electrochemistry Series, 1986 **Science 20, Unit 3**

Format	Video (10 min.)
Annotation	The causes and results of electrolysis, a non-spontaneous reaction requiring a source of electrical energy, are shown through animation. We discover that studying the reduction potentials for each possible half-cell reaction enables us to predict which reaction will occur. (*Authorized Student Support for Chemistry 30*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC324806

Fibre Optics, 1988 **Science 30**

Format	Video (20 min.)
Annotation	Tells of the scientific revolution brought on by a glass fibre thinner than a human hair. Shows applications in communications where its higher quality and capacity has led to its rapid use for voice and data transmission. Shows how the fibres are made. (*Authorized Student Support)*
Price	Contact LRDC/distributor
Distributor	Omega Films

Fifty More Things You Can Do to Save the Earth, 1989 **Science 20**

Format	Print
Annotation	Outlines some of the environmental problems we face and suggests practical household and community things that young people can do to make a difference. (*Authorized Student Support for Environmental and Outdoor Education*)
Price	$7.65
Author	Earthworks Group
Distributor	LRDC 0EV0729

Fifty Simple Things Kids Can Do to Save the Earth, 1989 **Science 20**

Format	Print	
Annotation	A summary of the environmental problems we face and practical things that young people can do to make a difference. (*Authorized Student Support for Environmental and Outdoor Education*)	
Price	$8.75	
Author	J. Javna	
Distributor	LRDC	0EV07003

Fixing Fuels: Organic Chemistry Series, 1987 **Science 20, Unit 3**

Format	Video (9 min.)	
Annotation	A look at common fossil fuels and the possible non-biological origin of methane. Through an examination of butane, the concept of isomers is developed, and methods of removing impurities from natural gas, and fractional distilling of petroleum, are studied. (*Authorized Student Support for Chemistry 20*)	
Price	See ACCESS Network catalogue	
Distributor	ACCESS Network	VC324904

Gaia: An Atlas of Planet Management, 1984 **Science 20**

Format	Print	
Annotation	This publication examines global human and environmental problems that threaten to disrupt and exhaust life support systems on Earth. Solutions to better planet management are proposed. The resource presents a political bias that may be of concern to some people. (*Authorized Student Support for Environmental and Outdoor Education* and *Social Studies 20*)	
Price	$17.95	
Author	N. Myers (ed.)	
Distributor	LRDC	0SS07076

Global Warming: Hot Times Ahead, 1990 **Science 30, Unit 2**

Format	Video (23 min.)
Annotation	An actor leads the way through this exploration of the global warming phenomenon and some of the devastating changes that may result. The viewer learns about greenhouse gases and how they are produced by human activities, chiefly the burning of fossil fuels. The film illustrates how the buildup of greenhouse gases can be slowed in the short term, by conserving and using gases efficiently, and how, in the long term, new ways need to be developed to use the Sun's energy. (*Authorized Student Support for Biology 20*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC331101

Glues: Organic Chemistry 2 Series, 1988 **Science 30, Unit 2**

Format	Video (10 min.)
Annotation	A look at a variety of adhesives, and the specific consumer and industrial tasks they perform. Also, the two bonding processes of glues—chemical polymerization and physical interlocking—are studied. (*Authorized Student Support for Chemistry 20*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network

Great Expectations: Recycling in Alberta, 1990 **Science 20**

Format	Video (29 min.)
Annotation	Explores the problems that make the establishment of recycling industries difficult. The program demonstrates that recycling is an economic activity like any other, and that recycling is only one of the "Four R's" of waste management. (*Authorized Student Support*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC705101

Heath Chemistry, Canadian Edition, 1987 **Science 20–30**

Format	Print Teacher's Edition ISBN 0669952907 Text ISBN 0669952893
Annotation	This high school chemistry text focuses on student understanding of basic chemistry principles, with special emphasis on proportional reasoning in chemistry calculations. (*Authorized Teaching Resource* and *Authorized Student Support for Chemistry 20–30*)
Price	$64.95 Teacher's Edition $49.95 Text
Author	J. Dudley Herron et al.
Distributor	D. C. Heath Canada Ltd.

Home Energy Analysis and Tutorial (Heat) Kit (The), 1988 **Science 30, Unit 4**

Format	Classroom Kit
Annotation	This "heat" kit introduces energy efficient house design and construction. It describes simple design features that allow increased use of passive solar heating in a home. Materials and construction techniques that increase the efficiency of energy use are also introduced. The kit includes: student worksheets, house plans, reference material, and a teacher's guide. (*Authorized Student Support for Physics 20*)
Price	Contact LRDC
Distributor	LRDC

Home and Family Guide: Practical Action for the Environment, 1989 **Science 20**

Format	Print
Annotation	Clear, practical information on how to tackle environmental issues in day-to-day life, recognizing that, collectively, we can have a tremendous influence on the environment. (*Authorized Student Support for Environmental and Outdoor Education*)
Price	$6.20
Author	L. Ward-Whate, Harmony Foundation of Canada
Distributor	LRDC 0EV07026

Immune System (The): Your Magic Doctor, 1988 **Science 30**

Format	Video (21 min.)
Annotation	An explanation, through the use of animation, of how the immune system works. (*Authorized Student Support*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network

Invitations to Science Inquiry, 1990

Science 20–30

Format	Print	ISBN 1878106007
Annotation	The book is designed for science teachers. The rise of discrepant events in the teaching of science is one of the best methods to arouse interest and curiosity in students. Each event is set up in such a way that it poses a question to the student and asks him or her to come up with an explanation. The description of discrepant events is organized to provide the teacher with the maximum guidance for conducting a science inquiry lesson. Emphasis has been placed on the use of simple material so that most of the events may be carried out with things that are found in everyday life or can be bought in local stores. (*Authorized Teaching Resource*)	
Price	Contact LRDC/distributor	
Author	Tik Liem	
Distributor	Science Inquiry Enterprises	

Kananaskis Country Environmental Education Teaching Activity Guide: Earth Science, 1987

Science 20

Format	Print	
Annotation	This guidebook has three units: Earth History, Geologic Processes and Geologic Materials. Activities in each unit have been arranged by topics that elaborate on one or more key concept(s) in environmental education. Key concepts include: change, adaptation, ecosystems, interdependence, cycles, resources and technology. While building on the students' knowledge and skills, the activities also encourage an examination of personal values and attitudes. (*Authorized Teaching Resource for Environmental and Outdoor Education*)	
Price	$29.25	
Author	R. Langsfeld, Calgary Board of Education	
Distributor	LRDC	0EV07028

Life After Chemistry: Organic Chemistry 2 Series, 1988

Science 30, Unit 2

Format	Video (10 min.)
Annotation	This is a study of dioxin, one of the thousands of spent chemicals that are buried daily, and how it enters the ecosystem. Effective disposal and recycling should be researched with an urgency matching that of product development. (*Authorized Student Support for Chemistry 20*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network

Life Science: Principles of Biology: The Living Textbook Series, 1988 — Science 20–30

Format	Videodisc
Annotation	A three-videodisc set, this program contains more than 2700 slides, 150 diagrams and 163 movie clips covering molecular, cell, plant, animal and human biology. Included are a 650-term glossary and 1000 of Oxford Scientific's best photos. Movie clips cover detailed biological processes, such as: cell biology, from protein synthesis to living cells; reproduction, from spermatogenesis to frog development; human biology, covering a whole range of systems and their functions; protist biology; fungi, from bread mould to zoospore release; plant reproduction and life cycles; invertebrates; and vertebrate biology, including behaviour and interaction. Molecular, cell and human biology (Sides 1 and 2) have curricular fit to Science 10, Biology 20–30 and Science 20–30. Plant and animal biology (Sides 3, 4, 7 and 8) offer a comprehensive survey of life science. Mechanisms of stability and change (sides 7 and 8) have curriculum fit to Science 10 and Science 20–30 as well. Teachers should be aware that some frames contain detailed dissections of vertebrates. *(Authorized Student Support)*
Price	Contact LRDC/distributor
Distributor	LRDC/Perceptix Inc.

Moving Mountains: Senior High Science Video Series, 1990 — Science 20

Format	Video
Annotation	The theory of plate tectonics is used to explain the formation of the Rocky Mountains, with a focus on how theories are formulated and how they predict and explain natural phenomena. This program supports the Science 20 course, and will help some secondary science teachers to broaden their background in geology. *(Authorized Student Support)*
Price	See ACCESS Network catalogue
Distributor	ACCESS Network BPN 302206

Natural Regions of Alberta—Poster Series, 1990 **Science 20, Unit 2**

Format	Resource Manual and Five Posters
Annotation	The main objective of the poster series and resource manual is to illustrate the beauty as well as the geological, geographical and environmental diversity in Alberta. It provides suggestions of activities to help teachers integrate posters into their daily lessons. (*Authorized Teaching Resource for Junior High Science*)
Price	$29.95
Author	Alberta Recreation, Parks and Wildlife
Distributor	LRDC 0SC07042

Natural Selection, 1985 **Science 20**

Format	Video (30 min.)
Annotation	Part 1: Natural Selection and Microevolution Part 2: Gradualism Versus the Punctuated Theory of Evolution This program explains how the principles of natural selection account for the changes in life forms as evidenced by the fossil record. (*Authorized Student Support*)
Price	Contact ACCESS Network
Distributor	ACCESS Network

Newton's First Law, 1987 **Science 20**

Format	Video (27 min.)
Annotation	Acts as an inservice training resource for teachers learning how to teach physics conceptually. The program is also useful to students in that labs are demonstrated skillfully by experts in the field of physics. Supplements Addison-Wesley's Conceptual Physics: A High School Course, and demonstrates the law of inertia. (*Authorized Student Support*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC305201

Newton's Third Law, 1987 Science 20

Format	Video (27 min.)
Annotation	Explains the law of action and reaction. Aids the teacher in preparing and supplementing in-class lectures and demonstrations, and acts as an inservice training resource for teachers learning how to teach physics conceptually. The program is also useful to students in that labs are demonstrated skillfully by experts in the field of physics. (*Authorized Student Support*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC305301

One-minute Readings: Issues in Science, Technology and Society, 1992 Science 20–30

Format	Print
Annotation	Contains readings and questions related to issues in science, technology and society. Applications of science are raising tough questions and are creating problems that cannot yet be answered. The book is intended to give students practice in making the kinds of decisions they will experience in life. Students need a knowledge of science to find not necessarily the right answers, but the best possible answers. (*Authorized Teaching Resource*)
Price	$10.50 Student Book $7.90 Teacher Manual
Author	R. F. Brinkerhoff
Distributor	LRDC

Perspectives in Science Series, 1989 Science 20–30

Format	Laserdisc Videocassette Videodisc
Annotation	This series begins with a 30-minute introductory video, The Program in Action, and then three, one-hour interactive videos exploring the topics biotechnology, toxic waste and water. A major step is made toward the science–technology–society connection. The series develops critical thinking about science and technology, examines basic applications, and points out unforeseen problems or complications often emerging as a consequence. Introductions contain docudramas with strong language and confrontation. (*Authorized Student Support*)
Price	$345 Videodisc
Distributor	Laserdisc Technovision Inc. Videocassette National Film Board of Canada Videodisc Technovision Inc.

Physical Science: Cosmic Chemistry: The Living Textbook Series, 1991 Science 20–30

Format Videodisc

Annotation *Cosmic Chemistry* deals with the abstract concepts critical to understanding the role of chemistry in everyday applications. Four, double-sided videodiscs are filled with still images, computer graphics, animations and movies. This program offers topics ranging from interstellar elements and environmental cycles to the atomic and molecular structures of chemical compounds. There is an extensive visual collection, including laboratory demonstrations performed by the Weird Science team and other noted chemists. Many of the dramatic demonstrations cannot be replicated in the classroom. Laboratory safety is emphasized. Historical still images and archival movie footage include pioneering scientists and inventors, the bombing of Hiroshima, the explosion of the Hindenburg and the theatrical transformation of Dr. Jekyll into the character of Mr. Hyde.

Sections on laboratory safety, consumer and environmental chemistry and the chemistry of the cosmos foster inquiry and informed decision making about a variety of issues. Topics covered on the videodiscs are as follows:

Side 1: safety, atomic structure, nuclear chemistry
Side 2: physical properties
Side 3: chemical changes
Side 4: metals, nonmetals
Side 5: acids and bases, redox and electrochemistry
Side 6: periodicity, organic chemistry
Side 7: beauty and biochemistry, chemical consumption
Side 8: atmospheric pollution, chemical hazards, cosmic chemistry

(Authorized Student Support)

Price Contact distributor

Distributor LRDC/Perceptix Inc.

Physical Science: Principles of Physical Science: The Living Textbook Series, 1987

Format	Videodisc
Annotation	A two-videodisc set, this program provides more than 2500 slides, 300 diagrams, a 325-term visual glossary and 90 movie clips for a comprehensive survey of physical science. Movie clips cover the structure of matter, including atomic theory and radioactivity; states of matter, including solids, liquids and gases; the conservation of energy; mechanics, including Newton's and Kepler's laws with examples; wave motion; light and sound, including refraction, polarization and energy levels; electricity and magnetism, including an electrochemical cell, magnetization, electromagnetics and aurorae observations. Matter, motion and forces (Sides 1 and 2) and waves, electricity and magnetism (Sides 3 and 4) offer a comprehensive survey of chemistry and physical science. Both videodiscs have curricular fit to Science 10, Chemistry 20–30, Physics 20–30 and Science 20–30. *(Authorized Student Support)*
Price	Contact LRDC/distributor
Distributor	LRDC/Perceptix Inc.

Physics: Cinema Classics, 1993

Format

Videodisc

Annotation

The American Association of Physics Teachers (AAPT) conceived the idea of collecting classic physics films successfully used by thousands of teachers for decades. They contain a wealth of demonstrations and lab experiments applicable to the current Physics 20–30 Program of Studies. D. C. Heath Canada is planning to correlate a teacher's guide of the basic student text to this resource. *(Authorized Student Support)*

Features

- 248 chapters organized by physics principles
- almost 2000 video segments and/or still images
- over 290 000 individual frames in the 2000 segments/images
- on-screen instructor's hints for each chapter
- uses two audio tracks, with discussion and explanation narrative accompanying most video segments
- frequent use of on-screen graphics

Side A: Mechanics
Side B: Mechanics II and Heat
Side C: Waves
Side D: Waves II and Electricity and Magnetism
Side E: Conservation Laws
Side F: Angular Momentum and Modern Physics

Price

Physics: Cinema Classics Videodisc and Directory: $969.10

Distributor

LRDC

Physics: Principles with Applications, Third Edition, 1991 **Science 20–30**

Format	Print	ISBN 0136725104
Annotation	Written at an introductory college level, this text uses algebra and elementary trigonometry, but not calculus. The applications of physics concepts include a wide range of examples from biology, medicine, architecture, technology, Earth sciences, the environment and daily life. (*Authorized Teaching Resource*)	
Price	Contact LRDC/distributor	
Author	Douglas C. Giancoli	
Distributor	Prentice-Hall Canada Inc.	

Planet Under Pressure Series, 1991 **Science 20–30**

Format Video: 20-minutes each; five of them apply to Science 20, and three videos have been authorized for Science 30.

Annotation (***Authorized Student Support***)

Acid Assault (The) **Science 30**
Beginning with a chemical overview of acids and bases, the program explains the formation, chemical nature and effects of acid rain on biota. The deaths of a lake and a tree are described in detail, and viewers see how changes in pH can have disastrous results on the environment.

Comfort Blanket (The) **Science 20**
This analysis of Earth's atmosphere illustrates the blend of elements that protects life in the biosphere and acts as a planetary thermostat. Also, a discussion of solar radiation and the role of carbon dioxide and other gases in trapping heat and providing a "comfort blanket" for life on Earth.

Oxygen Partnership **Science 20**
A look at the atmosphere's composition and role as a heat engine and solar shield. The program explores the relation among the evolution of life and the appearance of oxygen in the atmosphere, the development of the ozone layer, and implications of shifts in the balance of atmospheric components. A note to teachers: The statement, "We are terminating a three billion year experiment," which reflects humankind's impact on the Earth, could be discussed from a variety of perspectives.

Ozone **Science 30**
The 1980s discovery of a hole in the ozone layer was the beginning of the end for chlorofluorocarbons, once touted as harmless wonder chemicals. The program explains the chemistry of destruction of the ozone layer caused by the buildup of CFCs in the atmosphere.

Sharing Carbon **Science 20**
Exploring the fundamental concept of the carbon cycle through the four "spheres," this program shows how movement of carbon and other elements throughout the global biosphere supports life. The biosphere's capacity to adjust to changes in the balance of nutrients is explored, and the disruptive influence of human activity on these global systems is discussed.

Water, Water Everywhere **Science 20–30**
A look at the properties of water and its chemical and physical abilities to dissolve and transport minerals and nutrients. A sewage treatment operation is examined and the properties of hazardous waste are discussed. A note to teachers: The statement, "Poison the lifeblood of the planet," which reflects humankind's impact on the Earth, could be discussed from a variety of perspectives.

Winds of Change **Science 20**
Relating changes in global temperature to extinction of species through history, this program speculates that the projected global warming will result in mass extinction. As increased concentrations of carbon dioxide and methane trap heat in the atmosphere, the potential for disaster grows.

Price Contact distributor

Distributor ACCESS Network

Polyethylene: Organic Chemistry Series, 1987 **Science 20, Unit 3**

Format	Video (9 min.)
Annotation	This is the history and development of polyethylene, beginning with a daring experiment conducted in Britain in the 1930s. The program looks at how polyethylene is processed and manufactured to create light, durable and chemically inert products. (*Authorized Student Support for Chemistry 20*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC324905

Sewage Treatment, 1992 **Science 30**

Format Video (22 min.)

Annotation This video looks at the technical response to changing community standards on sewage treatment:

- primary treatment: screening, settling, anaerobic digestion, chlorination

  20 years ago—biogeochemical oxygen demand
  - secondary and tertiary treatment: trickling filter, aerobic digestion, ponding

  10 years ago—nutrients, phosphorus and nitrogen
  - excessive growth in rivers, chemical removal, biological removal, activated sludge process

  today—new processes
  - biodigestion, membrane filtration, magnetic process, dissolved air process

(*Authorized Student Support*)

Price Contact LRDC/distributor

Distributor Classroom Video

Science Process and Discovery, 1989

Science 20–30

Format	Print Text ISBN 0201186284 Teacher's Guide ISBN 0201186314
Annotation	• Examines significant events in the history of science and topics of current research through the use of short case studies. • Written for the general-level science student, but allows deeper analysis of the scientific method for the more advanced student. • Short narrative articles are followed by two different question sets. • Analysis provokes thinking about the cycle of proof and scientific principles. • Accompanying teacher's guide contains objective questions for each narrative. (*Authorized Teaching Resource*)
Price	Contact LRDC/distributor
Author	Dennis Field
Distributor	Addison-Wesley Publishers Limited

Senior High Science Video Series, Programs 1–5, 1990

Science 20–30

Format	Video
Annotation	Program 1: Baking Better Science (BPN 302201) Program 2: Zapped (BPN 302202) Program 3: Teaching from the STS Approach: The Nature of Science (BPN 302203) Program 4: Teaching from the STS Approach: Science and Technology (BPN 302204) Program 5: Teaching from the STS Approach: The Social Context of Science and Technology (BPN 302205) Programs 2 to 5 are teacher inservice video programs and are available on one tape. Programs 3 to 5 show teachers practising science–technology–society strategies and interviewing educators and students about these methods. The teachers involved were practising the strategies in their classrooms in the fall of 1990—before implementation of most of the new programs, Science 14–24 being the exception. (*Authorized Student Support*)
Price	See ACCESS Network catalogue
Distributor	ACCESS Network

Two Minutes a Day for a Greener Planet, 1990

Science 20

Format	Print	
Annotation	Quick and simple things you can do to save the Earth. (*Authorized Student Support for Environmental and Outdoor Education*)	
Price	$4.20	
Author	M. Lamb	
Distributor	LRDC	0EV07005

Understanding Biology, No. 2, 1991

Science 20–30

Format	Print	ISBN 0801625246
Annotation	Written at an introductory college level, this text is organized into three broad areas: basic biological principles, ecology, the structure and function of organisms. The first half of the text is devoted to principles shared by all organisms, and the second half is devoted to particular organisms, with an emphasis on vertebrate biology. (*Authorized Student Support for Biology 20–30*)	
Price	$67.43	
Author	Peter H. Raven and George B. Johnson	
Distributor	C. V. Mosby Co. Ltd.	

Water Quality Questions: The Nature and Importance of Water Quality Variables in Alberta, 1988

Science 20, Unit 2

Format	Print	
Annotation	Uses the topic of Alberta water to bridge scientific, technological and social aspects in a relevant and realistic way. The package includes a student booklet, a teacher's guide, "river monitoring" masters and overhead transparencies. The program also includes a special "indoor field study". Workshops are provided by Alberta Environment. (*Authorized Teaching Resource* and *Authorized Student Support for Junior High Science*)	
Price	$1.95 Student Package $18.50 Teacher Package (free with workshop from Alberta Environment)	
Author	Alberta Environmental Protection	
Distributor	LRDC	Student Package 0SC07056 Teacher Package 0SC07055

What Can We Do for Our Environment: Hundreds of Things to Do Now, 1990 **Science 20–30**

Format	Print
Annotation	Hundreds of ideas for things each of us can do to protect and improve our environment. (*Authorized Student Support for Environmental and Outdoor Education*)
Price	Free on request (limited quantity)
Distributor	Environment Canada

Other Learning Resources: General

The resources identified below have not been evaluated by Alberta Education. These listings are not to be construed as an explicit or implicit departmental approval for use. They are provided as a service only to assist school authorities to identify resources that contain potentially useful ideas. The responsibility to evaluate these resources prior to selection rests with the user, in accordance with any existing local policy.

Note: Prices of resources were listed as provided by distributors, May 1993. Check with distributor for current rates.

Laboratory Interfaces

Champ II — **Science 20–30**

Format	MS–DOS and Macintosh versions
Annotation	Users perform/analyze experiments using probes, software and computer hardware.
Price	Contact distributor
Distributor	Merlan Scientific

Leap — **Science 20–30**

Format	MS–DOS/Apple II/Macintosh
Annotation	Users perform/analyze experiments using probes, software and computer hardware. Interdisciplinary Lab Pac (physics/chemistry) and Biology and Principles of Technology Lab Pac (applied physics) are available. Lab pacs include manuals, interface card, software and several probes/cables.
Price	Contact distributor
Distributor	Quantum Technology Inc.

Personal Science Lab — **Science 20–30**

Format	MS–DOS
Annotation	Users perform/analyze experiments using probes, software and computer hardware.
Price	Contact local distributor for price list
Distributor	Contact local software distributor

Interactive Physics **Science 20**

Format	Macintosh
Annotation	Users create experiments by drawing objects on a screen. They adjust physical quantities, such as mass, friction, elasticity and gravity, to explore their effects on an experiment. Each set of exercises consists of a series of activities that involve modifying and observing experiments. The results of the experiments are then analyzed mathematically and conceptually. Because real experiments are visually simulated, students learn by exploring and hypothesizing. 1. Stability 2. Free-fall in One Dimension 3. Relative Velocity and Acceleration 4. Newton's First Law 5. Newton's Laws: Mass and Acceleration 6. Mass and Weight 7. Uniform Circular Motion 8. Rotational Kinematics 9. Centre of Mass 10. Linear Momentum 11. Collisions on an Air Track 12. Two-dimensional Collision 13. Elastic Potential Energy and the Work Done by a Spring 14. Elastic Potential Energy, Gravitational Potential Energy and The Work Done by a Spring 15. The Spring-launched Ball 16. Power
Price	$249
Distributor	Contact local software distributor

LXR Test **Science 20–30**

Format	Macintosh
Annotation	Test-generating program in three versions: personal, professional and scoring editions. The item banks from Alberta Distance Learning Centre have been created on the Scoring Edition to take full advantage of its additional features; however, the item bank will also work with the other two editions. For novices, there may be some "challenges" associated with using the Personal Edition.
Price	Personal – $599 U.S. (Site Licence) Professional – $799 U.S. (Site Licence) Scoring – $999 U.S. (Site Licence)
Distributor	Logic eXtension Resources

Science 20 Assessment Resources Package (Item Bank) **Science 20**

Format	LXR Test, ASCII text file and print
Annotation	This resource consists of four unit examinations and one year-end examination for Science 20. Three packages are available. 1. LXR Test format (5 disks) and print copy 2. ASCII text file (Macintosh and MS–DOS formats) and print copy 3. Print only
Price	Contact LRDC
Distributor	LRDC

SimEarth **Science 20–30**

Format	MS–DOS/Macintosh/Windows
Annotation	This is a planet simulator—a model of a planet. It is based on the Gaia theory by James Lovelock, which suggests that we look at our planet and the life on it as a whole and not as separate areas of study. The planet is treated as a whole: life, climate, the atmosphere, and the planet itself—from dirt and rock to the molten core—all affect each other.
Price	Check local software distributor
Distributor	Contact local software distributor

Videodiscs

Videodiscs and multimedia libraries are distributed by companies in Canada. See Distributor Addresses at the end of this document.

Evolution: Inquiries into Biology and Earth Science, 1992 **Science 20**

Format	Videodisc	ISBN 156307088X
Annotation	Package components: Evolution Videodisc—CAV, 1 side; Teacher's Guide, annotated, 370 pages; Student Manuals (biology or Earth sciences) (D) Textbook and videodisc; (T) Textbook only 1. Change (D) 2. How Long Is a Long Time? (D) 3. Patterns and Purpose (D) 4. Can Humans Live on Mars? (D) 5. Adaptive Radiation and Convergence (D) 6. Rate of Evolutionary Change (T) 7. Trace Fossils (D) 8. Variation in the Fossil Record (D) 9. Mass Extinction and Adaptive Radiation (T) 10. Science and the Age-of-the-Earth Debate (T) 11. Methods of Science (T) 12. Humans and Apes: A Question of Origins (D) 13. Where Have All the Dinosaurs Gone? (D) 14. Natural Selection (D) 15. Adaptation (D) 16. Grouse: An Evolution Problem (D) 17. Grouping Objects and Animals (D) 18. Genetics and Evolution (T) 19. The Evolution of Human Disease (D) 20. Human Variation, Evolution and Modern Disease (T) 21. Cultural Evolution (D)	
Price	Evolution: Biology Package $495 Evolution: Earth Science Package $495 Additional Student Manuals $100 (set of 10) or $15 each	
Distributor	Videodiscovery Inc.	

Garbage: The Movie—An Environmental Crisis, 1990

Science 20–30

Format	Videodisc (24 min.)
Annotation	This is a look at the problem of the environment and solid waste, presented in the vernacular of students. Landfills, incinerators, recycling plants and composting yards are visited. The reasons why landfills are closing, how the garbage crises is creating pollution and the search for the roots of the problem are explored. Some solutions offered are: recycling, reusing, reducing use, and consumer choices and organized action.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network BPN 331001

Geology and Meteorology, 1985

Science 20–30

Format	Videodisc
Annotation	Contained on one videodisc, this program provides more than 7200 slides, a 400-term glossary and 34 movie clips for a thorough review of Earth geology. The slide collection includes plate tectonics, volcanic formation and the many ongoing weathering processes affecting the Earth. Movie clips examine volcanoes, including Vesuvius and Heimaey Island; tectonics, including the dynamics of continents and the evolution of North America; meteorology, including rain and cloud droplets, thunderstorms, hurricanes and tornadoes; weathering, including glacial melting, erosion and cratering; and rocks and minerals, including composition, formation and lunar rock samples.
Price	Multimedia Library $995 U.S.; Discs only $595 U.S.
Distributor	Optical Data Corporation

Our Environment, 1990

Science 20–30

Format	Videodisc
Annotation	Contained are 6000 environmental colour photos sequenced with explanatory captions, maps, diagrams and film segments. The disc, organized for easy use, includes: • the four spheres of air, water, land and organisms • a focus on important environmental problems, such as acid rain, energy usage, climate change, desertification, wetlands loss, tropical deforestation, oil spills, nuclear power and weapons, soil erosion, solid waste, species extinction, asbestos and water pollution • a visual glossary illustrating over 700 environmental terms and surveying the globe with captioned photos.
Price	Videodisc $395 U.S.; Teacher Manual $30 U.S.; Student Manual $15 U.S.; HyperCard Stacks $70 U.S.
Distributor	Optilearn

Physics and Automobile Collisions, 1984 **Science 20**

Format	Videodisc
Annotation	Using footage of car collisions, this disc provides a graphic way to study the principles of momentum, Newton's laws, and mechanical energy. Collisions are recorded in eleven chapters on the disc, while an audio track emphasizes key concepts during the motion. Students then analyze the action using freeze-frame control, and measure the screen to gather data. Appropriate for three levels of physics instruction: descriptive physics, the algebra/trigonometry course in college physics, and calculus-based engineering physics.
Price	$303.75
Distributor	Videodiscovery Inc.

Physics of Sports, 1988 **Science 20**

Format	Videodisc
Annotation	This detailed record of over twenty athletic events, filmed expressly for scientific analysis, provides visual data from which quantitative data can be collected by biomechanics, kinesiology and physics students. The videodisc is used to step through actions in 1/30 second intervals. Using a sheet of clear acetate over the image on the monitor, students can study each position and collect data on such physical principles as linear motion, projectiles, energy transformation, momentum, impulse and time. This is one way of applying physics to real-world problems. Included is a student handbook and a teacher's guide detailing how the disc can be used in a typical physics curriculum, directory of the images, formulas and step by step instructions.
Price	$741.15
Distributor	Videodiscovery Inc.

Plate Tectonics and Continental Drift, 1992 **Science 20**

Format	Laserdisc
Annotation	A comprehensive resource highlighting the concepts of plate tectonics and continental drift from a global perspective.
Price	$57.15 U.S.
Distributor	EME Incorporated

Teacher Background

Acid Rain: A North American Challenge, 1988 **Science 30**

Format	Video (15:46 min.)
Annotation	Summarizes what is known today about the causes and effects of acid rain, a threat to our environment.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network

Alberta: A Natural History, 1979 **Science 20**

Format	Print
Annotation	The whole of the natural history of Alberta is included in a single volume. There are studies of rock strata, fossil remains, flora and fauna. Discussed are the complex interrelationships of organisms, the impact of humankind on the environment and the conservation of natural resources. This publication was distributed to Alberta school libraries as a result of the Alberta Heritage Learning Resources Project.
Author	Charles D. Bird et al.
Distributor	Contact local school library

Canadian Environmental Education Catalogue: A Guide to Selected Resources and Materials, 1991 **Science 20–30**

Format	Print
Annotation	Contains a comprehensive list of environmental resources.
Price	$20 main volume; $40 two-year subscription (main volume plus supplementary volumes, one every 6 to 8 months)
Distributor	Pembina Institute

Career Connections Series, 1993

Format: Print

Annotation

Summary: This series outlines the educational background needed to qualify for different careers in a variety of areas. Personal profiles and comments from individuals are featured.

Great Careers for People Interested in How Things Work
ISBN 1895579082
Author: Peter Richardson and Bob Richardson

Describes careers such as: inventor, chemical research analyst, automotives mechanic.

Great Careers for People Interested in the Human Body
ISBN 1895579066
Author: Lois Edwards

Describes careers such as: family physician, respiratory technologist, community health nurse.

Great Careers for People Who Like Being Outdoors
ISBN 1895579104
Author: Helen Mason

Describes careers such as: park naturalist, practical forester, farmer.

Great Careers for People Concerned About the Environment
ISBN 189557904X
Author: Lesley Grant

Describes careers such as: environmental chemist, lawyer, health specialist.

Great Careers for People Interested in Math and Computers
ISBN 1895579023
Author: Peter Richardson and Bob Richardson

Describes careers such as: mathematics consultant, video games programmer, audio engineer.

Great Careers for People Interested in Living Things
ISBN 1895579007
Author: Julie Czerneda

Describes careers such as: plant scientist, museum biologist, equestrian coach.

Price: Contact distributor

Distributor: Weigl Educational Publishers Limited

Chemistry: A First Course, 1987 **Science 20–30**

Format	Print	ISBN 020117880X
Annotation	This introductory high school chemistry text presents the basic concepts of chemistry in a clear and understandable manner, using numerous practical examples. The text examines some of the major social issues confronted by the Canadian chemical industry.	
Price	$34.20	
Author	Geoffrey Rayner-Canham and Arthur Last	
Distributor	Addison-Wesley Publishers Limited	

Chemistry: A Second Course, 1988 **Science 20–30**

Format	Print	ISBN 0201178850
Annotation	This text is written for a senior-level high school chemistry course. The relevance of chemistry is emphasized by examining some current environmental questions.	
Price	Contact distributor	
Author	Geoffrey Rayner-Canham and Arthur Last	
Distributor	Addison-Wesley Publishers Limited	

Clarification of Statements Prohibiting the Use of Human Body Substances in the Alberta Science Curriculum, 1988 **Science 20–30**

Format	Print	
Price	$2.80	
Author	Alberta Education	
Distributor	LRDC	0XF00012

**Clouds in a Glass of Beer:
Simple Experiments in Atmospheric Physics, 1987** **Science 20–30**

Format	Print	ISBN 0471624829
Annotation	Contains experiments for diffusion, heat transfer, conservation of energy, kinetic potential, solar radiation, the freezing point of water and cloud formations.	
Price	$17.48	
Author	Craig F. Bohren	
Distributor	John Wiley & Sons Canada Ltd.	

Complete Handbook of Science Fair Projects (The), 1991 **Science 20–30**

Format	Print	ISBN 0471527297(c) 0471527289(p)
Annotation	Contains 50 award-winning projects from actual science fairs, described in detail with accompanying illustrations and 500 other suggested science fair topics suitable for junior and senior high science students. Detailed guidelines for preparing a science fair project are outlined. This includes selection of topic, obtaining materials, recording data and suggestions for oral presentation.	
Price	$18.50	
Author	Julianne Blair Bochinski	
Distributor	John Wiley & Sons Canada Ltd.	

Conceptual Physics, Sixth Edition, 1989 **Science 20–30**

Format	Print	ISBN 0673398471
Annotation	Physics is treated conceptually, rather than mathematically, in this text. The concepts are presented and equations are used as guides for thinking, rather than recipes for algebraic problem solving.	
Price	$46.69 U.S.	
Author	Paul G. Hewitt	
Distributor	Scott, Foresman and Co.	

Conservation Strategy, 1988 Science 20–30

Format	Print (pamphlets)
Annotation	This series of discussion papers covers: • Tourism in Alberta • Agricultural Considerations for Today and Tomorrow • Healthy Planet, Healthy People • Oil and Gas in Alberta: An Uncertain Future • Foundations for the Future: Alberta's Mineral Resources • Energy Conservation: A Goal for Albertans • Renewable Energy: The Power and the Potential • Environment by Design • Reserves for Nature • A Place for Wildlife • Environmental Education for a Sustainable Future • Dinosaurs and Distant Drums • Perspectives for an Alberta Conservation Strategy • Resolving Conflict: A Case Study • Alberta Conservation Strategy: Strategic Framework in Action • Alberta Conservation Strategy: Strategic Framework in Brief • Alberta Wetlands: Water in the Back • Our Dynamic Forests: The Challenge of Management • People, Parks and Preservation • Electricity: Development for a Sustainable Future • Saving the Strands of Life: Alberta's Biodiversity
Price	Free on request
Author	Alberta Conservation Strategy Project
Distributor	Environmental Council of Alberta

CRC Handbook of Hazardous Laboratory Chemicals: Information and Disposal, 1991 Science 20–30

Format	Print ISBN 084930265X
Annotation	This handbook has information about physical properties, fire hazards, chemical properties, hazardous reactions, physiological properties and health hazards, spillage disposal, waste disposal, and appropriate reactions to spillage and waste disposal.
Price	$95 U.S.
Author	M. A. Armour
Distributor	CRC Press

Destination Conservation, 1990 **Science 20–30**

Format	Print
Annotation	This manual was written especially for schools seeking to improve their energy, water and waste management practices, and covers:

1. The Program Begins
    - Initial Awareness Activities
    - Determining Energy and Resource Consumption Levels
2. Taking Action
    - Energy Audit and Action Plan
    - Conservation Campaign
    - Resource Audit and Action Plan
3. Further Awareness and Action
    - A Global Perspective
    - Individuals Can Make a Difference
    - Environmental Connections
    - Overpopulation
    - Energy and the Environment
    - Transportation
    - Global Warming/Greenhouse Effect
    - Ozone Layer Depletion
    - Deforestation
    - Water Conservation
    - Ecological Landscaping and Gardening
    - Waste Management
    - Cost Recovery Program for Paper
    - Hazardous Materials

Price	$35
Distributor	Environmental Resource Centre

Environmental Issues/An Overview, 1989 **Science 20–30**

Format	Print
Annotation	The Canadian Petroleum Association has produced a series of pamphlets on important environmental issues, including sour gas, waste management, water quality and oil spills in Canada's frontiers. This particular pamphlet is an overview of the industry's concern for environmental matters, research and safety, industry and the community, industry and the government, and industry and the economy.
Price	Free on request
Distributor	Canadian Association of Petroleum Producers

Focus on Research: A Guide to Developing Students' Research Skills, 1990

Science 20–30

Format	Print	
Annotation	Outlined is a resource-based research model to help students manage information efficiently and effectively, and gain transferable skills to all school and work situations. The model provides a developmental approach to teaching students how to do research.	
Price	$3.60	
Author	Alberta Education	
Distributor	LRDC	0XS01016

Frontiers of Space Planet Earth: The View from Space, 1990

Science 20–30

Format	Print	ISBN 0674670701
Annotation	This is a concise, up-to-date overview of ongoing international research efforts toward improving our ability to predict global climate change. Remote sensing from space is described. The text reviews space-based satellites and their instruments, and describes the areas in which operational and research missions are gathering ever-increasing data on Earth–Sun interaction, land vegetation patterns, ocean colour, temperature, atmosphere, ice sheets of the polar regions, shape and motion of the Earth's crust, and Earth's gravity field; all of which fill in gaps in our knowledge, even as they raise new questions about critical global processes.	
Price	Contact distributor	
Author	D. James Baker	
Distributor	Harvard University Press	

Fundamentals of Physics: A Senior Course, 1986

Science 20–30

Format	Print	ISBN 0669950475
Annotation	This text is written for a senior-level high school physics course and provides a thorough examination of basic physical concepts. It is algebra-based with many examples drawn from everyday life.	
Price	Contact distributor	
Author	David G. Martindale, Robert W. Heath and Philip C. Eastman	
Distributor	D. C. Heath Canada Ltd.	

Green Future: How to Make a World of a Difference, 1990 **Science 20–30**

Format	Print	
Annotation	Explores major environmental issues and offers practical suggestions for daily positive action.	
Price	$14.05	
Author	L. Johnson	
Distributor	LRDC	0EV07008

Health and Safety on the Job: Audio-Visual Catalogue, 1992 **Science 20–30**

Format	Print (catalogue)
Annotation	Lists several AV resources available from Alberta Occupational Health and Safety Library Services
Price	Free on request
Distributor	Alberta Labour Library

History of Physics (The), 1985 **Science 20–30**

Format	Print	ISBN 0802707513
Annotation	*The History of Physics* is divided into three parts. The first, "Motion, Sound, and Heat", considers physics from an essentially Newtonian viewpoint. Beginning with the study of motion and the work of Galileo, Asimov progresses to Newton's synthesis of the laws of motion and the laws of universal gravitation to the conservation laws of momentum, angular momentum and energy, and the laws of sound and heat. The second, "Light, Magnetism, and Electricity", considers physics from the viewpoint of the late nineteenth century and early twentieth century. Asimov explores the properties of light and colour, of magnetic fields and electric currents, and finally Einstein's theory of relativity and Planck's quantum theory, which helped initiate the second scientific revolution in the first decades of the twentieth century. The third part, "The Electron, Proton, and Neutron", considers the physics of modern times—the study of the world of the infinitesimally small. Asimov tells of the discovery of the structure of the atom, of radioactivity, nuclear fission and fusion, and of the inner workings of the atom's nucleus. Finally, a new appendix covers the last frontier in physics—the family of fleeting elementary particles (muons, quarks, leptons and their siblings)—and how everything may be tied together by grand unified theories.	
Price	$40.43	
Author	Isaac Asimov	
Distributor	Thomas Allen and Sons	

Levitating Trains and Kamikaze Genes: Technological Literacy for the 1990s, 1991 **Science 20–30**

Format	Print ISBN 0060973692
Annotation	This is a guide to technological literacy with a list of topics on space technology, biotechnology, computer literacy, energy, superconductivity, high technology, health and transportation.
Price	$11.95
Author	Richard P. Brennan
Distributor	Harper Collins Books of Canada Ltd.

Living Flow—Teaching Kit (The), 1992 **Science 20**

Format	Print
Annotation	This resource includes a teaching guide, two copies of a poster, and duplicating masters on the back of one of them. The topics addressed are sources of water in Alberta, uses of water, water conservation and management.
Price	Free on request
Distributor	Alberta Environmental Protection

Nature of Life (The), 1989 **Science 20–30**

Format	Print ISBN 0075570351
Annotation	This introductory college-level text is clearly written, richly illustrated, and organized around three unifying themes: • living things take in energy to maintain their internal order and organization • living things undergo reproduction so that the species continues after the individual ceases to exist • living organisms are able to adapt to changing environments.
Price	$58.16
Author	John H. Postlethwaite and Janet L. Hopson
Distributor	McGraw-Hill Ryerson Ltd.

Occupational Health and Safety Publications List and Order Form **Science 20–30**

Format	Print
Annotation	Lists several publications available from Alberta Occupational Health and Safety.
Price	Free on request
Distributor	Alberta Labour Library

Physical World (The), 1991 **Science 20–30**

Format	Print	ISBN 0174384092
Annotation	*The Physical World* deals with the forces that shape the world, from the smallest particle to the galaxies of stars comprising the Universe. It also deals with the way forces and energy are used by all of us—in living and moving, in work and play, in sending messages, in storing information, and in controlling so many things in the modern world. This book could be used as a source of science–technology–society ideas for questions and class discussion.	
Price	$20.30	
Author	Ken Dobson	
Distributor	Nelson Canada	

Physics, Third Edition, 1988 **Science 20–30**

Format	Print	ISBN 047185221X
Annotation	This text is written for introductory college level, with particular emphasis on applications of physics principles in the life sciences. It makes extensive use of examples involving biological and chemical systems and alternative energy sources.	
Price	$80.93	
Author	Joseph W. Kane and Morton M. Sternheim	
Distributor	John Wiley & Sons Canada Ltd.	

Problems in Chemistry, 1990 **Science 20–30**

Format	Print	ISBN 0074526650
Annotation	Each chapter contains a summary of key concepts and several questions related to the concepts; for example, problems and solutions in acid–base chemistry and chemical equilibrium are addressed Complete answers are given for some questions, while others have answers only.	
Price	Contact distributor	
Author	Roland Smith	
Distributor	McGraw-Hill Ryerson Ltd.	

Recycling in Canada **Science 30**

Format	Print (factsheets)
Annotation	These factsheets provide examples of several successful recycling programs across Canada.
Price	Free on request
Distributor	Environment Canada

Reduction and Reuse: The First 2 R's of Waste Management **Science 30**

Format	Print (brochure)
Annotation	This resource includes information about residential wastes, commercial and institutional wastes, and suggestions for reduction and reuse.
Price	Free on request
Distributor	Environment Canada

Science Matters: Achieving Scientific Literacy, 1991 **Science 20–30**

Format	Print	ISBN 038526108X
Annotation	The aim of this book is to provide the information needed to become scientifically literate. It contains chapters on: Scientific Literacy, Knowing Energy, Electricity and Magnetism, The Atom, The World of the Quantum, Chemical Bonding, Atomic Architecture, Nuclear Physics, Particle Physics, Astronomy, The Cosmos, Relativity, The Restless Earth, Earth Cycles, The Ladder of Life, The Code of Life, Evolution, and Ecosystems.	
Price	Contact distributor	
Author	Robert M. Hazen and James Trefil	
Distributor	Doubleday Canada Ltd.	

Senior High Science Inservice Modules, 1992 **Science 20–30**

Format	Print	
Annotation	The following thirteen modules are contained in this package. Module 1 – Teaching for Thinking Module 2 – STS Teaching Strategies Module 3 – Controversial Issues in the Classroom Module 4 – Focus on Research Module 5 – Science 10: A Hands-on Sampler Module 6 – Performance Assessment in Science 10 Module 7 – Technology and Media in the Classroom Module 8 – Cooperative Learning Module 9 – Teaching for Conceptual Change Module 10 – Teaching with Gender Balance Module 11 – Questioning Techniques Module 12 – Environmental Connections in the New Programs Module 13 – Agricultural Connections in the New Programs	
Price	$25 for complete package—not available individually	
Author	Alberta Education	
Distributor	LRDC	OSC10128

State of Canada's Environment (The), 1991 **Science 20–30**

Format	Print	ISBN 066014236
Annotation	This report covers environmental concerns and what Canadians are doing to address them. What are the key environmental conditions and trends in Canada? What are the links between human activities and environmental changes? What are the ecological, economic and health implications of these dangers?	
Price	$29.95	
Author	Environment Canada	
Distributor	Environment Canada	

Structured Questions for Environmental Science, 1990 **Science 20–30**

Format	Print	ISBN 0340524006
Annotation	Teachers are provided with a source of science–technology–society questions which can be used for class tests, discussions and assignments.	
Price	Contact distributor	
Author	C. L. Liffen	
Publisher	Hodder & Stoughton Ltd.	
Distributor	Pippin Publishing Ltd.	

STS Science Education: Unifying the Goals of Science, 1990 **Science 20–30**

Format	Print	
Annotation	This publication provides a comprehensive description to help teachers integrate science–technology–society concepts into their teaching strategies.	
Price	$3.05	
Author	F. Jenkins	
Distributor	LRDC	0XS10017

Teaching Thinking: Enhancing Learning, 1990 **Science 20–30**

Format	Print	ISBN 1550062271
Annotation	Principles and guidelines for cultivating thinking, from Early Childhood Services to Grade 12, have been developed in this resource. It offers a definition of thinking, describes nine basic principles upon which the suggested practices are based, and discusses possible procedures for implementation in schools and classrooms.	
Price	$4.25	
Author	Alberta Education	
Distributor	LRDC	0XS00125

Together We Learn (Cooperative and Small-group Learning), 1990 **Science 20–30**

Format	Print/Video
Annotation	This practical "how to" handbook is designed to help teachers implement small group learning strategies in the classroom. It offers the following: • a nuts and bolts approach to cooperative learning that provides classroom suggestions and aids • thorough coverage of cooperative learning approaches to assist teachers of varying levels of experience with group work • suggestions that are relevant to all grades, disciplines and students • a jargon-free, easy to read, treatment of cooperative learning techniques.
Price	Contact distributor
Author	R. Wideman et al.
Distributor	Print: LRDC 0SS07073 Video: ACCESS Network

Triumph of Discovery (The):
Women Scientists Who Won the Nobel Prize, 1991

Science 20–30

Format	Print Hardcover ISBN 0671693328 Softcover ISBN 0671693336
Annotation	The Nobel Prize laureate is one of the most sought after of international honours. Nearly 500 Nobel prizes have been awarded to scientists, ten of whom were women. This book tells the story of four of these female scientists from their early struggles to their breakthrough discoveries. Maria Goeppert – fought prejudice toward women in science to study physics in her native Germany. Her work helped lead to the development of the atomic bomb and experimentation with shell models. Rosalyn Yalow – a scientist, wife and mother, whose study of nuclear physics led her to discover ways of "tagging" substances in blood with radioactive tracers. Barbara McClintock – overcame the opposition of her family to attend college and devote her life to the study of maize genetics. Rita Levi-Montalcini – survived anti-Semitism in facist Italy to train as a doctor and biologist investigating nerve growth.
Price	$13.98 U.S. Hardcover 8.95 U.S. Softcover
Author	Joan Dash
Distributor	Julian Messner, a division of Silver Burdett Press Inc.

Waste Paper Recycling in Canada

Science 30

Format	Print (factsheets)
Annotation	Discusses the "players" involved in the recycling process, collecting post-consumer waste, and markets for recycled paper products.
Price	Free on request
Distributor	Environment Canada

World of Chemistry: Saunders Golden Sunburst Series, 1991 **Science 30**

Format	Print	ISBN 003030167X
	Instructor's Manual and Test Bank	ISBN 0030301734
Annotation	The text uses a science–technology–society approach to the study of chemistry. The instructor's manual includes answers to chapter questions and multiple choice questions for each chapter.	
Price	Contact distributor	
Author	Melvin D. Joesten et al.	
Distributor	Harcourt Brace and Company Canada	

World of Physics (The), Volume III: The Evolutionary Cosmos and the Limits of Science, 1987 **Science 20–30**

Format	Print	ISBN 0671499319
Annotation	This volume concentrates on the developments in physics in the twentieth century and the application of the principles of relativity and quantum theory to such phenomena as stars, black holes and the evolution of the Universe.	
Price	$29.95	
Author	Jefferson Hane Weaver	
Distributor	Simon and Schuster	

Other Learning Resources: Science 20

The resources identified below have not been evaluated by Alberta Education. These listings are not to be construed as an explicit or implicit departmental approval for use. They are provided as a service only to assist school authorities to identify resources that contain potentially useful ideas. The responsibility to evaluate these resources prior to selection rests with the user, in accordance with any existing local policy.

Note: Prices of resources were listed as provided by distributors, May 1993. Check with distributor for current rates.

Unit 1: The Changing Earth

Alberta: A Natural History, 1979

Format	Print
Annotation	This book is unique in its treatment in that the whole of the natural history of a province is included in a single volume. There are studies of rock strata and fossil remains as well as the fauna and flora of Alberta. It discusses the complex interrelationships of organisms, the impact of man on the environment and the conservation of natural resources. This book was distributed to Alberta School Libraries as a result of the Alberta Heritage Learning Resources Projects.
Author:	Charles D. Bird et al.
Distributor:	Contact local school library

Blue Planet (The): Circulation of the Oceans: Planet Earth Series, 1986

Format	Video (28 min.)
Annotation	Studies the dynamic properties of oceans. Reviews some historical aspects of the oceans. Looks at oceanography from space.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC313404

Blue Planet (The): Physical and Chemical Makeup of the Oceans: Planet Earth Series, 1986

Format	Video (28 min.)
Annotation	Demonstrates various observational techniques used to describe the geophysics of the ocean floor and the chemistry and physics of sea water.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC313403

Burgess Shale: Impressions of Life: The Nature of Things Series, 1991

Format	Video (46 min.)
Annotation	Small, multicelled creatures appeared in the oceans in what is known as the Cambrian explosion, some 550 million years ago. They were the first animals on Earth. All animals today, including the human species, go back in a direct line of descent to those first ancestors. Traces of these first animals have been preserved in fossil from a deposit in British Columbia, high in the Rocky Mountains in Yoho National Park. The deposit is known as the Burgess Shale. This program is a one-hour update of a previous show from **The Nature of Things**.
Price	1/2" - $109; 3/4" - $160
Distributor	CBC Educational Sales

Climate Change Digest: Exploring the Implications of Climate Change for the Boreal Forest and Forestry Economics of Western Canada, 1988

Format	Print (booklet)	ISBN 08353980
Annotation	This report summarizes the initial results of a preliminary study to assess the implications of carbon dioxide-induced climate change for the boreal forests of the Prairie provinces and the Northwest Territories. The objective of the study was to assess the current state of knowledge of climate change influences on tree growth and physiology, to develop a framework to assess the use of climate change/forest/economic models, and to undertake preliminary climatic change impact assessments. The report identifies significant gaps in the knowledge of how the forest will respond to climate change, and also makes clear that future changes in climate caused by the greenhouse effect could have a significant impact on the boreal forests of Western Canada.	
Price	Free on request	
Distributor	Canadian Climate Centre, Climate Services Division	

Climate Puzzle: Climates—Past, Present and Future: Planet Earth Series, 1986

Format	Video (28 min.)	
Annotation	Shows that present world climate is not typical of that which prevailed during most of geological time. Explores the changing factors that brought this about.	
Price	See ACCESS Network catalogue	
Distributor	ACCESS Network	VC313406

Darwin, Naturally: Organic Evolution Series, 1986

Format	Video (10 min.)
Annotation	The stage is set for Charles Darwin, who theorized that nature imitates the selective hand of humans in controlling variation within a species. Darwin coined the phrase "natural selection" to explain how variations within species are preserved or rejected.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC289502

Development of Natural Gas in a Northern Community (The), 1992 [also for Science 20, Units 2, 3]

Format	Print
Annotation	This is a role-play exercise of a public hearing. At issue is a petroleum company's application to develop a natural gas field in Northern Canada and pipe the product south. Students play the roles of various interest groups and present their positions to an energy hearing board. The board must then make recommendations and explain them to all groups.
Price	$7.50
Distributor	Petroleum Communication Foundation

Dinosaur Footprints of the Peace River Valley, 1978

Format	Video (15 min.)
Annotation	One of the world's largest concentrations of dinosaur footprints was left 120 million years ago along what is now the Peace River Canyon in north eastern British Columbia. This program follows a 1978 expedition of paleontologists who mapped the trackways and made molds and rock cuttings of the footprints in order to study the environment and behaviour of dinosaurs.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC219501

Dinosaurs: The Nature of Things Series, 1985

Format	Video (59 min.)
Annotation	Examined are the physical characteristics and adaptations of dinosaurs and how inferences about their characteristics can be made based on the fossil record.
Price	$147.15
Distributor	CBC Educational Sales

Dinosaurs and Their Descendants: Life on Earth Series, 1981

Format	Video (30 min)
Annotation	The largest and most imposing land animals of all time were the dinosaurs. These early reptiles began to evolve from reptilian stock about 250 million years ago in great profusion and variety, dominating the Earth's surface for about 150 million years. Although dinosaurs varied in size from the very small to the very large, the latter have gained the most attention. The vegetarian brontosaurus, for example, weighed 30 tons. Considering the lack of comparably-sized land animals today, one wonders why it grew so large. Two likely reasons are feeding requirements and temperature control. The later was an issue for all dinosaurs. Assuming they were largely ectomorphic like other reptiles, dinosaurs would have needed devices for keeping their temperatures up to properly functional levels. Tricerotops was a vegetarian of formidable dimension and armor; eight tonnes, almost a two-tonne head with plates and horns containing a good-sized brain. Yet tricerotops became extinct, along with every other species of dinosaur. Moreover, all this happened rather abruptly about 63 million years ago. The question is "Why?" One commonly held theory is that they perished in a global catastrophe, such as the collision of a large celestial body with Earth. Another is that they perished in competition with the faster, smarter, warmer-blooded mammals who began to prey on their eggs. The fossil records tell another story, one of significant climatic change during the period of dinosaur extinction.
Price	Contact distributor
Distributor	Visual Education Centre

Earth and Atmosphere: Pathways Through Science Series, 1993

Format	Print	ISBN 0582094097
Annotation	This module contains teaching strategies and 62 activities dealing with rocks, plate tectonics, weather and the solar system. Examples of some of the investigations are the weather, the study of rocks and sediments, aging of rocks, patterns in the Earth's crust and discovering planets. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections related to the Earth sciences, the solar system and Earth's atmosphere. A study guide outlines main ideas for review. Some of the examples used have a British context.	
Cost	$69.56	
Distributor	Copp Clark Pitman Ltd.	

Earth Has a History, 1990

Format	Video (20 min.)
Annotation	This program describes the relative ages of rock layers, using geologic principles.
Price	Rental $112; Purchase $474
Distributor	Visual Education Centre

Earth Revealed Series, 1992

Format	Video (30 min.)
Annotation	A series of 26 half-hour programs, hosted by James L. Sadd, Ph.D., a geologist and professor at Occidental College in Los Angeles. Sadd brings a wealth of knowledge to the program through his work in petrology and geochemistry and professional work as a geologist and geotechnical/environmental consultant for the energy industry. Programs 1 to 10 may be useful for Science 20, Unit 1. **Program 1: Down to Earth** The vast field of geology is introduced through the use of visuals depicting the wonders of the Earth. **Program 2: The Restless Plant** Revisits the beginning of the solar system and the evolving Earth. **Program 3: Earth's Interior** Demonstrates how seismic waves occur and explains how the measurement of gravity, heat flow and Earth magnetism provide information about Earth's interior. **Program 4: The Sea Floor** Examines major sea floor features: the midoceanic ridge, oceanic trenches and fracture zones. **Program 5: The Birth of a Theory** Traces the origins of continental drift and sea floor spreading, and their role in plate tectonics theory. **Program 6: Plate Dynamics** Introduces theory and concepts about the movements of Earth's plates. **Program 7: Mountain Building** Shows how major mountain belts and continents have evolved. **Program 8: Earth's Structures** Illustrates how bedrock responds to tectonic forces originating within Earth. **Program 9: Earthquakes** Explores the nature and consequences of earthquakes, the factors that cause quakes, their locations and characteristics. **Program 10: Geologic Time** Covers the vast amounts of time over which geologic processes have been at work. **Program 11: Evolution through Time** Chronicles the development of life on Earth.
Price	$99 each
Distributor	Magic Lantern Communications Ltd.

Earth Science for Every Kid: 101 Easy Experiments That Really Work, 1991

Format	Print	ISBN 0471530107
Annotation	Outlined are 101 experiments dealing with the Earth, sea and air. Each experiment is broken down into its purpose, a list of materials, step by step instructions, expected results and a scientific explanation. These experiments could be used as simple applications to complex concepts in Earth sciences.	
Price	$13.95	
Author	Janice Van Cleave	
Distributor	John Wiley & Sons Canada Ltd.	

Earth Science: 49 Science Fair Projects: Science Fair Projects Series, 1990

Format	Print	ISBN 0830632875
Annotation	Provided are innovative home and classroom science projects designed specifically with science fair competitions in mind. This book may be an appropriate reference for the selection of experiments in Earth sciences, for example in Science 20, Unit 1. The experiments are simple and can be used as demonstrations and initiators of complex topics.	
Price	Contact distributor	
Author	Robert L. Bonnet and G. Daniel Keen	
Distributor	Tab Books	

Earthquakes, 1990

Format	Video (15 min.)
Annotation	Probes the origin and nature of seismic waves, using vivid scenes of earthquake effects. Examines P and S waves, epicentres, transcurrent and transform faults with emphasis on the San Andreas fault and subduction zone earthquakes. Relates seismic activity to plate tectonics. There is an extensive section planning for what to do in the event of an earthquake.
Price	$79 U.S.
Distributor	EME Incorporated

Earthquakes, 1989

Format	Print (brochure)
Annotation	This brochure includes information about: what could happen; what you can do to be prepared in the event of an earthquake and afterward.
Price	Free on request
Distributor	Public Information Planning and Services Directorate

Flesh on the Bones: Dinosaur Series, 1992

Format	Video (55 min.)
Annotation	Follows the recent discoveries made by scientists about the nature of dinosaurs. The program answers questions like: Were dinosaurs slow moving or speedy? Were they hot- or cold-blooded? How large were they? Did they eat plants or each other? How did they chew and digest? The answers come from ingenious research in the fields of biology, physiology, geology and biomechanics.
Price	Contact distributor
Distributor	Visual Education Centre

Form and Function of Fossils: The Earth Explored Series, 1987

Format	Video (27 min.)
Annotation	Describes how geologists reconstruct the life habits of a particular fossil, emphasizing the different ways in which paleontologists determine the swimming capabilities of extinct animals, using homology with living relatives, analogy with unrelated but similar organisms, or by using experimental models and paleontological information, such as a Mosasaur's tooth marks.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC279802

Gaia: Goddess of the Earth, 1985

Format	Video (50 min.)
Annotation	What keeps the atmosphere of the Earth breathable? Or the oceans from freezing, or boiling dry? According to Dr. James Lovelock, the answer lies in the gases produced by plants and bacteria; in the bodies of minute sea creatures; and in mass poisoning which took place two billion years ago. For Lovelock's controversial Gaia hypothesis—named after the ancient Greek goddess of the Earth—suggests that life itself manipulates the planet to ensure its own survival; that the Earth and all living things upon it are part of a single, self-regulating system. During the 1960s Lovelock worked for the National Aeronautics and Space Administration (NASA), developing techniques to detect life on Mars. In the course of his work he came to realize that if life were present on Mars then the evidence for it would be observable through the telescope—as a strange mixture of gases in the Martian atmosphere. On Earth, this mix—which contains a very low level of carbon dioxide—is the result of living organisms absorbing and expelling gases. Another remarkable fact about the Earth is that the global temperature has remained within very narrow limits for the last 3.5 billion years. These thoughts led to the development of the Gaia hypothesis and the idea that life on Earth actively controls the environment to enhance its own chances of survival. The biggest test of Gaia would be its ability to withstand a mass extinction, such as that which wiped the dinosaurs from the Earth. Recent theories suggest that such extinctions occur at regular intervals. One of the strangest explanations for this is that the Sun has a twin star called Nemesis, which visits the solar system every 26 million years and showers the Earth with comets, causing the widespread death of many species. If so, will Gaia be able to meet the challenge when Nemesis returns again in a few million years, or has the goddess become so vulnerable with age that the Earth will be radically changed?
Price	$495
Distributor	BBC Enterprises

Gifts from the Earth: Energy Resources: Planet Earth Series, 1986 [also for Science 20, Unit 3]

Format	Video (28 min.)
Annotation	Discusses the inherently limited nature of fossil fuels, investigates their origin and distribution, and explores alternatives for future use. Examines coal, oil, gas and uranium, along with alternative energy sources.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC313409

Glaciers, 1989

Format	Video (15 min.)
Annotation	Award-winning photography shows glacial erosion and decomposition in action. Advancing ice masses carve U-shaped valleys and leave a trail of lakes and erratics, while melting glaciers deposit kames, drumlins and outwash plains. Covers alpine and continental glaciation. Animation sequences help explain key processes.
Price	$79 U.S.
Distributor	EME Incorporated

Greenhouse, 1990 [also for Science 20, Unit 2]

Format	Video (30 min.)
Annotation	This program examines part of the scientific process that has led to predictions of greenhouse warming. It describes the greenhouse effect in detail and follows the "classical science" processes of observation and description, the search for regularities and connections between data and the formulation of probable explanations for why connections exist. Testing these "most probable explanations" is frequently done, using computer models, and by describing how simple mathematical models have developed into remarkably useful predictive tools. Program Summary Observations • the Earth's past temperatures, using oxygen isotopes on ice cores • the quantity of greenhouse gases and the increases Deducing the Mechanisms • making computer mathematical models • the size of the grid and the simplifications • the various factors, such as glaciers, clouds, cities, plants, etc. Predicting the Future • maps made by some of the different computer models Testing the Predictions • by starting with known data in the past and seeing if it accurately predicts present conditions
Price	$69
Distributor	Classroom Video

Greenhouse Effect . . . To What Degree?, 1990

Format	Video (22 min.)
Annotation	Provides a holistic perspective on the greenhouse effect issue and discusses the factors contributing to global warming. Computer modelling is used to project warming trends and the effects of various alternatives now available.
Price	$49.95
Distributor	Canadian Learning Company

Habitat Turned Hothouse (A): Icewalk Series, 1989

Format	Video (22 min.)
Annotation	An early thaw creates perilous formations of grinding ice that threaten the Icewalk explorers as they near the Pole. Could it be global warming that instigates the thaw? Slogging in 12-hour intervals, they finally triumph, arriving shortly after dawn on May 14, 1989. In this program, the greenhouse effect and the resulting damage to the environment are examined. The program concludes with the International Student Expedition presenting a unanimous declaration, calling for people everywhere to work together—just as the explorers did—for the survival of the world.
Price	Contact distributor
Distributor	Visual Education Centre

Impacts of Global Warming (The)

Format	Print (factsheet)
Annotation	Describes some of the possible effects of a warmer climate on selected sectors of Canada, based on changes suggested by recent climate studies. Also available—factsheets: "The Greenhouse Gases", "Climate Change and Variability".
Price	Free on request
Author	Atmospheric Environment Service
Distributor	Environment Canada

In the Beginning: Organic Evolution Series, 1986

Format	Video (9 min.)
Annotation	Although the Biblical account of creation was widely accepted, several eighteenth-century scientists unwittingly challenged the creation model and laid the groundwork for the theory of organic evolution. This program examines the contributions of pioneers Carl Linnaeus, le Comte de Buffon and Jean Lamarck to modern theory.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC289501

Living Machine (The): Continental Tectonics and the Earth's Interior: Planet Earth Series, 1986

Format	Video (28 min.)
Annotation	Tells how it is possible to discern the remarkably detailed internal structure of Earth from indirect evidence obtained at the Earth's surface. Shows how a few basic concepts of the principle of geophysical techniques are used for this purpose.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC313402

Living Machine (The): Plate Tectonics: Planet Earth Series, 1986

Format	Video (28 min.)
Annotation	Studies the mobility of Earth's surface, the ephemeral nature of the ocean floors, and the cause and effect relationship between this mobility and the principal surface activity on the Earth, such as earthquakes, volcanoes and mountain building.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC313401

Natural Connections: The Nature of Things Series, 1988

Format	Video (48 min.)
Annotation	New insights gained from particle physics, astronomy and molecular biology present a dramatically extended view of evolution, seen as an unbroken progression from the formless, intense energy of the big bang 14.5 billion years ago to the complex patterns of the current ecosystem. The program traces the path from the creation of matter to the formation of the stars and in them the atoms and molecules of life, of genes, of cells and eventually of multicelled creatures like humans.
Price	1/2" - $109; 3/4" - $160
Distributor	CBC Educational Sales

North Sea 1: The Tectonic Framework: Sedimentary Processes and Basin Analysis Series, 1987

Format	Video (58 min.)
Annotation	Presents two models of sedimentary basin formation and development—McKenzie and Wernicke—and demonstrates how the case for each has been argued and interpreted in terms of petroleum geology.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC269515

North Sea 2: The Origin and Migration of Hydrocarbons: Sedimentary Processes and Basin Analysis Series, 1986

Format	Video (29 min.)
Annotation	Focuses on the origin and nature of source rocks, how petroleum is generated, and how the timing of generation, migration and reservoir formation is evaluated. The main example used is the Brent field.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC269516

Oil Sands Interpretive Centre, 1993

Format	Print (brochure), Field Trip Information
Annotation	The Fort McMurray Oil Sands Interpretive Centre presents the history, technology and the future of the Athabasca Oil Sands. Self-guided tours take 2 to 2½ hours for the Centre and Industrial Equipment Garden and 2½ hours to tour the Oil Sands Viewpoint and the Syncrude Plant. Guided tours are also available.
Price	Free on request
Distributor	The Fort McMurray Oil Sands Interpretive Centre

Origins of Change: DNA and the Evidence for Evolution: The Evolution Series, 1985

Format	Video (20 min.)
Annotation	This program shows the structure and replicating processes of DNA and the effects of genetic mutation. It also demonstrates the Lederberg experiment, and recapitulates the evidence provided by fossils and structural and biological homologies to support the position that the process of adaptation and the selection of adapters rests on a wide range of genetic variability. After viewing the program, students should have a general understanding of the basic structure and functioning of DNA, the significance of the Lederberg experiment and be familiar with the range and types of evidence for evolution presented in the review section.
Price	$139 U.S.
Distributor	Films for the Humanities and Sciences

Our Petroleum Frontiers: Environmental Issues, 1989

Format	Print (brochure)
Annotation	Broad outline of Canada's petroleum industry: how it works, where our present oil and gas supplies come from, and where they will be in the years ahead.
Price	Free on request
Distributor	Canadian Association of Petroleum Producers

Our Petroleum Resources: Environmental Issues, 1989

Format	Print (brochure)
Annotation	Briefly describes origins, exploration, drilling, production, transportation, reserves, nonconventional resources, oil sands, heavy oil and the frontiers.
Price	Free on request
Distributor	Canadian Association of Petroleum Producers

Paleoguide: A Teacher's Guide to Paleontology, 1988

Format	Print
Annotation	Provides background to those concepts basic to an understanding of paleontology. It includes information on fossils, geologic time, a history of life on Earth, and dinosaurs. Distributed to every school in Alberta. Contact the Tyrrell Museum for copyright clearance.
Distributor	Tyrrell Museum of Paleontology, Educational Services

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Patterns of Diversity: Genetics Series, 1988

Format	Video (25 min.)
Annotation	Evolution—the adaptation of an animal to its surroundings over geological time—is still an area of controversy a century after the introduction of natural selection. Is evolution associated with random molecular drift of individual proteins in an organism, or is it a response to changes in the environment? How are such changes incorporated in genetic materials?
Price	$450
Distributor	Coronet Film and Video

Plate Tectonics, 1988

Format	Laserdisc/Video (15 min.)
Annotation	Comprehensive program on the development of the modern theory of an active restless Earth and its interior structure. Traces Wegener's ideas on continental drift to the discoveries of the midocean ridges, paleomagnetism, abyssal trenches, sea floor spreading, transform faults and the global pattern of shifting tectonic plates.
Price	$57.15 U.S.Laserdisc $79 U.S.Video
Distributor	EME Incorporated

Plate Tectonics: The Earth Explored Series, 1982

Format	Video (27 min.)
Annotation	The theory of plate tectonics helps to explain some of the most violent activities on the Earth's surface. This program uses animation and visits to sites, such as the Alps and active volcano areas, and shows how scientists measure the actual movement of the Earth's surface.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC279811

Plate Tectonics: The Puzzle of the Continents, 1990

Format	Video (18 min.)
Annotation	This videotape explores the scientific revolution that began with Alfred Wegener's hypothesis on continental drift and ends with today's theory of global plate tectonics. Computer graphics and live action video from locations around the world explain where crustal plates are found, why their interaction results in earthquakes and volcanoes, and how their perpetual movement is governed by convective forces deep within the Earth. Wegener's views on continental drift sparked a generation of scientific debate that has led to the rejection of the notion of crustal permanence and the acceptance of crustal movement and change. The Earth's crust, or lithosphere, is divided into large tectonic plates that move slowly—converging, diverging and sliding past each other. As plates slowly move, their borders become the focal points for recurrent seismic activity and volcanic eruptions. Plate tectonics theory has unified the fields of geology, physical oceanography, seismology and paleontology. Awareness of these processes will help scientists predict the geologic hazards that continue to plague millions of people who live along plate boundaries.
Price	$64.95 U.S.
Distributor	Scott Resources Inc.

Precious Envelope (The): The World of Chemistry Series, 1990

Format	Video (28 min.)
Annotation	The chemistry of our planet's atmosphere, how it may have formed, and how human activities affect its future is explored.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Restless Earth (The): Understanding the Theory of Plate Tectonics, 1985

Format	Video (43 min.)
Annotation	Alfred Wegener's theory of plate tectonics is explained, based on fossil record and other pieces of evidence.
Price	$285
Distributor	McIntyre Media Limited

Restless Rocks: Spaceship Earth Series, 1991

Format	Video (28 min.)
Annotation	From space can be seen how the continents formerly fitted together like pieces of an exploded jigsaw puzzle. The movements of continents set the stage for the present climatic epoch, with its particular distribution of mountain ranges and ocean currents. Where are the volcanoes of the world? Where are earthquakes likely to happen? Satellites make possible the first global watch on all volcanoes—in the sparsely inhabited regions or in the crowded landscapes of Vesuvius in Italy. As long as volcanoes seethe with unpredictable menace, can human beings claim to be in charge of events on spaceship Earth?
Price	$350
Distributor	T. H. A. Media Distributors

Sea-floor Spreading, 1990

Format	Video (11 min.)
Annotation	Introduces a scientific revolution. Shows how the "permanence" theory was replaced by sea floor spreading to explain the origin of the ocean basins. Covers the roles of magnetic anomalies and paleomagnetism, sediment studies and heat flow along the midocean ridge for verifying the new theory. A set of three lab exercises for use with the video is available. The exercises are: 1. Paleomagnetism and Magnetic Anomalies 2. Sediments Profile Across the Ridge 3. Heat Flow in the Ocean Basins
Price	$69 U.S.
Distributor	EME Incorporated

Seismic Reflection Processing: Sedimentary Processes and Basin Analysis Series, 1986

Format	Video (34 min.)
Annotation	Animation is used to explain the main steps in processing seismic sections, whether recorded on land or at sea, so that their information can be reliably interpreted.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC269509

Seismic Stratigraphy: Sedimentary Processes and Basin Analysis Series, 1987

Format	Video (49 min.)
Annotation	The branch of geology that deals with the arrangement of layered rock formations is being enhanced by the seismic technique of determining the correct sequence of stratification, even in areas where folding, faulting or erosion has taken place. The use of this technique will help establish a consistent geochronology for the entire Earth.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC269510

Setting the Stage: Bow Summit Edukit, 1981

Format	Video (14 min.)
Annotation	Establishes the location of the Bow Summit area and explores its formation through mountain building processes. Covered are the processes of sedimentation and compression, layer cake upthrust and glacial activity; i.e., erosion by water and ice.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC224501

Somebody Should Do Something About This, 1992

Format	Print
Annotation	This teacher resource is on energy and the environment. It provides background information on non-renewable energy sources, renewable energy sources, energy conservation and energy efficiency, and the environmental effects related to energy use and production. It is divided into sections for ease of use: activities, factsheets, additional resources, and an index with an alphabetical listing of energy and environmental terms.
Price	Free on request
Distributor	Alberta Energy

Adaptations—A Struggle for Survival: Bow Summit Edukit, 1981

Format	Video (10 min.)
Annotation	This video acquaints viewers with the various ways in which alpine plants adapt to the harsh growing conditions of the alpine and subalpine zones. How these pioneer plants adapt in their own unique ways is shown, for example: upturned and waxy needles, strong perennial root growth, large flowers to attract pollinating insects quickly, and mat plants.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC224504

Anatomy of an Oil Spill, 1990 [also for Science 20, Unit 3 and Science 30, Unit 4]

Format	Video (60 min.)
Annotation	In the black, early hours of Good Friday, 1989, what Dan Lawn saw in the viewfinder of his home video camera was a picture of his worst nightmare: the supertanker Exxon Valdez aground on Bligh Reef as millions of gallons of crude oil poured from its hull into Alaska's Prince William Sound. The long history of complacency, negligence and broken promises by government agencies and oil companies that led to this great Alaskan oil spill on March 24, 1989 is investigated.
Price	Contact distributor
Distributor	Visual Education Centre

And Then Came People: Bow Summit Edukit, 1981

Format	Video (10 min.)
Annotation	This program discusses the fragility of the plant life on Bow Summit and points out humankind's effect on its survival. Also addressed are the goals of Bow Summit, a project of Parks Canada, to help visitors understand and appreciate its natural beauty; and to preserve and protect it as a natural area.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC224505

Biomes: Aspects of Ecology Series, 1984

Format	Video (29 min.)
Annotation	Global patterns of climate result in a patchwork of local climates around the world, each with a corresponding formation of vegetation, or biome. The biomes of Alberta are explored.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC241805

Biomes: Coniferous Forest, 1989

Format	Video (12 min.)
Annotation	Of all the major forest biomes, the community with the smallest number of species is the coniferous forest, which forms a belt around the top of North America, Scandinavia and Siberia. This program surveys the flora and fauna common to the coniferous forest biome and explains adaptations and interrelationships that make this a viable environment for its inhabitants.
Price	$450
Distributor	Coronet Film and Video

Biomes: Desert, 1989

Format	Video (12 min.)
Annotation	Given the harshness of the desert biome, it is surprising to find how many plants and animals make this their home. Exploring the climatic and geographical reasons for the existence of deserts, this documentary details the unique adaptations of plants and animals to this difficult existence.
Price	$450
Distributor	Coronet Film and Video

Biomes: Grassland, 1989

Format	Video (12 min.)
Annotation	Located on every continent except Antarctica, grasslands exist wherever there is too little water to support forests but enough to prevent the formation of deserts—a quarter of the Earth's surface is covered by grasslands. Journeying through grasslands in Africa, America and Australia, viewers are shown how the plants and animals are similar and different.
Price	$450
Distributor	Coronet Film and Video

Biomes: Introduction, 1989

Format	Video (12 min.)
Annotation	A biome is identified as a community of living things occupying a large geographical area—a stable community whose composition of plants and animals is primarily influenced by their success in adapting to a particular climate. Comparing the physical and environmental characteristics of the six major biomes, this program shows how each is governed by two factors: light and water.
Price	$450
Distributor	Coronet Film and Video

Biomes: Tropical Rain Forest, 1989

Format	Video (12 min.)
Annotation	Confined today to areas near the equator, the rain forest is made possible by frequent and heavy rains (more than 380 cm per year) and the solar power of brilliant tropical sunshine. By exploring the multitude of life in the tropical rain forest, four distinct layers can be defined that help to explain the great diversity of life.
Price	$450
Distributor	Coronet Film and Video

Biomes: Tundra, 1989

Format	Video (12 min.)
Annotation	With less than 12 cm of precipitation each year, low temperatures all year long and a short growing season, the tundra forms a belt around the north polar regions of the world and is home to only a few hardy species of plants and animals. During the extremely short "summer", the tundra becomes the migratory home for a large number of short-term visitors from the coniferous forests to the south. Viewers discover why this happens, and how it affects the seasonal cycle of the tundra's permanent residents.
Price	$450
Distributor	Coronet Film and Video

Biosphere (The): Science Now Series, 1989

Format	Print	ISBN 0748702024
Annotation	The current scope of the topic "biosphere" is surveyed by presenting recent worldwide information. This illustrated text could be used for research purposes or as a source of questions and ideas for building test items and lesson plans.	
Price	$9.95	
Author	Thomas M. Steven and David Wright	
Distributor	Copp Clark Pitman Ltd.	

Can Polar Bears Tread Water?, 1990

Format	Video (60 min.)
Annotation	Climate is considered by many scientists and politicians to be second only to nuclear war in its potential for disrupting the human race. Shot around the world in the United States, China, Russia, Canada and the United Kingdom, this documentary analyzes the time scale of climate change and illustrates how people should respond to the dangers. In Canada, the focus is on the fight by a group of Native Indians against deforestation. Should the greenhouse effect be allowed to go unchecked, then polar bears may literally have to tread water. Global warming will have melted the ice.
Price	$425
Distributor	T. H. A. Media Distributors

Circles and Cycles: Aspects of Ecology Series, 1984

Format	Video (28 min.)
Annotation	This video examines the flow of energy through photosynthesis, food chains and food webs, and the flow of matter through the carbon and water cycles. Scientists illustrate these concepts by discussing the greenhouse effect, the effect of pesticides, and water diversion.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC241801

Climate for Growth (A): Bow Summit Edukit, 1981

Format	Video (10 min.)
Annotation	The interaction of several factors have a profound effect on the climate of the Bow Summit area. The program explains: prevailing winds, cooler temperatures, thin air and higher altitudes, ultraviolet radiation and the formation of soil.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC224502

Development of Natural Gas in a Northern Community (The), 1992

[see annotation Science 20, Unit 1]

Ecosystems: Aspects of Ecology Series, 1984

Format	Video (29 min.)
Annotation	Ecosystems are defined by illustrating the flow of energy, stability of ecosystems, abiotic and biotic factors, relationships, such as commensalism, and the hydrologic cycle and acid rain.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC241802

Energy Balance (The), 1986

Format	Video (15 min.)
Annotation	Energy balance in the biosphere is discussed, and atmospheric studies are conducted under various conditions.
Price	$99
Distributor	Coronet Film and Video

Environment: Pathways Through Science Series, 1993

Format	Print	ISBN 0582094062
Annotation	This module contains teaching strategies and 62 activities dealing with the environment. Examples of some of the investigations are mini-ecosystems, photosynthesis, food pyramids, global warming, sewage treatment and pollution. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections related to aquatic ecosystems, environmental sustainability, organic farming and biological control. A study guide outlines main ideas for review. Some of the examples used have a British context.	
Cost	$69.56	
Distributor	Copp Clark Pitman Ltd.	

Fate of the Earth (Part 1): Geochemical Cycles: Planet Earth Series, 1986

Format	Video (30 min.)
Annotation	The dynamic nature of ecological and other balances in nature are addressed, as well as the importance of taking extreme care where possibilities exist that the activities of humankind might upset these balances.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Forestry Biotechnology: Women in Science Series, 1990

Format	Video (20 min.)
Annotation	This is a career-oriented video in the field of forestry biotechnology. The program details the isolating and culturing of biological organisms that will perform a desired function in concert with a host environment. Dr. Paige Axelrood is isolating organisms that inhibit the growth of fusarium, a disease that can kill up to 20 per cent of conifer seedlings. She speaks of the requirement for balance in a science career—a balance of dedication, as well as outside interests. Anne-Marie Milosevich, biotechnology technologist, works in the same lab as does Dr. Axelrood. Her task is to isolate organisms that fix nitrogen. Once identified, these organisms could be incorporated with a seedling's growth medium to evolve with the seedling, lessening the need for external fertilizer input. Anne-Marie also provides interesting insights into the role of motherhood, while maintaining a career in science.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Greenhouse, 1990 [see annotation Science 20, Unit 1]

Home Composting: How to Build and Maintain a Compost Bin, 1987

Format	Print (brochure)
Annotation	This brochure has helpful hints about how to build and maintain a compost bin.
Price	Free on request
Distributor	Environmental Council of Alberta

Into Deep Water: Turning the Tide Series, 1988 [also for Science 30, Unit 2]

Format	Video (26 min.)
Annotation	David Bellamy looks at why clean drinking water is becoming a scarce commodity even in the richest countries. On a trip down the Thames he encounters pesticides, nitrates and heavy metals, just a few of the nasties posing problems for outmoded water and sewage works. He also tackles acid rain; and beaches polluted with raw sewage, garbage and radioactivity. We know how to clean it up. Why don't we?
Price	$350
Distributor	McNabb and Connelly Films

Nuclear Waste Management: Science Screen Report Series, 1988

[also for Science 30, Unit 4]

Format	Video (16 min.)
Annotation	What is nuclear energy? What is the difference between fission and fusion? Can the by-products of nuclear waste be disposed of safely? The importance of nuclear waste management is addressed and many of the questions about this energy alternative to fossil fuels are answered.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Patterns—A Mountain Patchwork: Bow Summit Edukit, 1981

Format	Video (9 min.)
Annotation	This program illustrates how vegetation patterns are determined by landscape and climate. The three distinct zones of vegetation on Bow Summit are presented: the subalpine on the lower slopes, the alpine on the higher slopes, and the tree line where the two zones converge.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC224503

Pesticide Education Program, 1991

[also for Science 20, Unit 3]

Format	Kit (5 parts)
Annotation	This resource consists of 5 parts. 1. Forest Tent Caterpillar Study 2. Mosquito Kit 3. Vegetative Management Study 4. Pesticide Education Unit 5. Weed Kit
Price	Free on request
Distributor	Alberta Environmental Protection

Populations: Aspects of Ecology Series, 1984

Format	Video (29 min.)
Annotation	This video explains the significance of population studies and explores the concepts of dispersal, density, limiting factors, "S" and "J" shaped curves, and the roles of natality, mortality and migration. These concepts are illustrated through an examination of certain plant and animal studies presently being done by biologists in Alberta.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC421803

Recognizing Herbicide Action and Injury, 1986

Format	Print
Annotation	Discover how to recognize the symptoms of herbicide-related causes of crop injury. Learn preventative steps. Understand the way herbicides work—how they move into plants, and where they go once inside them. Get to know where they move in the soils and how long they stay there. See what to look for when examining crops for damage and when checking weeds for signs of killing action.
Price	$8
Distributor	Alberta Agriculture, Food and Rural Development

Recycling in Canada

Format	Print (factsheets)
Annotation	These factsheets provide examples of several successful recycling programs across Canada.
Price	Free on request
Distributor	Environment Canada

Reduction and Reuse: The First 2 R's of Waste Management

Format	Print (brochure)
Annotation	This brochure covers information about residential wastes, commercial and institutional waste, and suggestions on how to reduce and reuse.
Price	Free on request
Distributor	Environment Canada

Shores of Life (The), 1990

Format	Video (28 min.)
Annotation	Between the dry land habitats of New Brunswick, Prince Edward Island and Nova Scotia and the salt water of the Atlantic, there is a vital band of wetland habitats. The shores are influenced by the sea and the land, creating ecological systems more diverse and more productive than either land or sea. At the heads of bays and along tidal rivers, broad cordgrass marshes are among the most biologically active places on Earth. At lower elevations, sunlit shallows produce beds of eelgrass and algae, which support an abundance of animal life. These are nursery areas for many species of commercial fish. The sea claws at headlands to create cliffs, which are used by nesting seabirds, while the eroded rock is redeposited to form beaches and sand dunes. The dunes may trap fresh water to create barrier beach ponds, unique additions to the complex of seashore habitats. This video explores the biological wealth of these Atlantic coastal wetlands, from the microbes of salt marsh tidepools, beachcombing sandpipers and the bald eagles of Bras D'Or to human harvest of fish and waterfowl. A separate, companion film, *Touched by the Tide*, looks at the wetlands influenced by giant tides in the Bay of Fundy. These videos could be useful in addressing the science–technology–society connections.
Price	Loaned free on request
Distributor	Ducks Unlimited Canada

Taking Action Through Backyard Composting to Reduce Household Waste

Format	Print (brochure)
Annotation	This brochure addresses such questions as: Why compost? What is composting? Also covered are steps to composting, materials to compost, how to start and maintain a compost pile, and trouble shooting.
Price	Free on request
Distributor	Alberta Environmental Protection

Touched by the Tide, 1990

Format	Video (28 min.)
Annotation	The waters of the Bay of Fundy rock back and forth, pushed into continual motion by the twice-daily pulse of the Atlantic tide. The result is the highest tides in the world, and a diversity of shoreline habitats, which support an array of plant and animal life. Near the mouth of the bay, upwelling currents create marine pastures, which attract great whales. Puffins and razorbills nest on rocky islands. In upper parts of the bay, there are broad expanses of red mudflats that are productive feeding areas for shorebirds and fish. Tidal bores force their way up rivers, reversing the flow of water, and conducting schools of fish toward freshwater spawning areas. Fundy's salt marshes were once the largest in Canada, but most have been dyked for agricultural use. Fundy's marshes, mudflats and rivers have provided harvest for the region's human populations, from the Micmac on through 350 years of European settlement. The Acadian culture was based on the farming of dykelands. This video explores the wetland habitats created by the giant tides of the Bay of Fundy, and traces the critical connections among their biological systems. A separate, companion film, *The Shores of Life*, looks at other types of wetland habitats in other parts of Canada's maritime coast. These videos could be useful in addressing the science–technology–society connections.
Price	Loaned free on request
Distributor	Ducks Unlimited Canada

Waste Paper Recycling in Canada

Format	Print (factsheets)
Annotation	These factsheets discuss the players involved in the recycling process, collecting of post-consumer waste, and markets for recycled paper products.
Price	Free on request
Distributor	Environment Canada

Weeds of the Prairie, 1983

Format	Print
Annotation	Learn to identify 93 common weeds. Get to know where they tend to grow, what features can be used to make a positive identification, and why each weed is of agricultural concern. This book features colour photos and illustrations of whole mature plants, seedlings, seeds and flowers.
Price	$15
Distributor	Alberta Agriculture, Food and Rural Development

Wetlands in Canada: A Valuable Resource

Format	Print (factsheet)
Annotation	This factsheet is a summary of studies undertaken by the Lands Directorate examining wetland conversion in several regions of southern Canada. It emphasizes the value of wetlands to Canadians, regional wetland conversion issues and statistics, and federal initiatives to protect remaining wetlands.
Price	Free on request
Distributor	Environment Canada

Age of Polymers (The): World of Chemistry Series, 1988

Format	Video (15 min.)
Annotation	This film is a demonstration of nylon making. There are graphical representations of fractional distillation, catalytic cracking and making polyethylene. Styrene and polystyrene are described. There is also a feature on recycling.
Price	$55 ($450 for series)
Distributor	Magic Lantern Communications Ltd.

Anatomy of an Oil Spill, 1990 [see annotation Science 20, Unit 2]

Chemistry of the Earth: World of Chemistry Series, 1988

Format	Video (15 min.)
Annotation	Several chemistry topics are reinforced through examples from geology. Solubility, precipitation, equilibrium and acid–base chemistry are applied in explaining mineral deposition and worldwide distribution of ores. Silicate minerals are used to illustrate the relationship between chemical structure and macroscopic properties. Cave formation and stalactite and stalagmite development are explained in a story about limestone.
Price	$55 ($450 for series)
Distributor	Magic Lantern Communications Ltd.

Development of Natural Gas in a Northern Community (The), 1992 [see annotation Science 20, Unit 1]

Ethanol Blended with Gasoline

Format	Print (factsheet)
Annotation	This factsheet discusses "The Environmental Burden of Fossil Fuels", "The Environmental Benefit of Ethanol-blended Gasoline" and "Which Ethanol-blended Gasoline Qualifies for the EcoLogo?"
Price	Free on request
Distributor	Environmental Choice Program

Gifts from the Earth: Energy Resources: Planet Earth Series, 1986 [see annotation Science 20, Unit 1]

Ions and Electrons in Metals: Chemistry: From Theory to Application, 1989

Format	Video (12 min.)
Annotation	In one electric circuit, electrons flow continuously in a copper wire. In the second circuit, copper forms only a part of the conductive path; the rest is an electrolytic solution and a platinum electrode. The film shows the migration of the copper ions and the removal and addition of electrons.
Price	$500
Distributor	Marlin Motion Pictures Ltd.

Making Materials: Pathways Through Science Series, 1993

Format	Print	ISBN 0582094100
Annotation	This module contains teaching strategies and 62 activities dealing with the testing and making of materials. Examples of some of the investigations are planning, record keeping and revision of materials. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections related to plastics and various hydrocarbons. A study guide outlines main ideas for review. Some of the examples used have a British context.	
Price	$69.56	
Distributor	Copp Clark Pitman Ltd.	

Materials: Pathways Through Science Series, 1992

Format	Print	ISBN 0582094046
Annotation	This module contains teaching strategies and 62 activities dealing with the physical and chemical properties of various substances. Examples of some of the investigations are how chemicals are made and used in industry and the home. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections related to the properties and uses of certain materials. A study guide outlines main ideas for review. Some of the examples used have a British context.	
Price	$69.56	
Distributor	Copp Clark Pitman Ltd.	

Our Petroleum Challenge in the 1990s, 1990

Format	Print
Annotation	This resource includes detailed information about the historical background of the petroleum industry, exploration drilling, processing, refining, products, pipelines, marketing and the frontiers challenging the industry today.
Price	$2
Distributor	Petroleum Communication Foundation

Oxidation–Reduction: World of Chemistry Series, 1988

Format	Video (15 min.)
Annotation	Topics covered in this film are electron transfer, corrosion, batteries, a feature on the pacemaker, and an introduction to electrolysis.
Price	$55 ($450 for series)
Distributor	Magic Lantern Communications Ltd.

Pesticide Education Program

[see annotation Science 20, Unit 2]

Petroleum: River of Energy, 1989

Format	Video (60 min.)
Annotation	The video is set up into 12 parts making it easy to stop or view only a few sections. The sections include: Birth of an Industry, Upstream, Exploration, Acquisition of Rights, Drilling, Production and Marketing, Natural Gas Processing, Oil Refining, Petrochemicals, Oil and Gas Pipelines, Marketing and Consumers, and Challenge of the Future. It was distributed to all junior high schools in Alberta.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC284301

Pipelines in Canada, 1989

Format	Print (brochure)
Annotation	This brochure includes information about pipeline transportation, history, oil pipelines, gas pipelines, environment and safety.
Price	Free on request
Distributor	Canadian Association of Petroleum Producers

Refined Motor Oil

Format	Print
Annotation	This factsheet discusses "The Environmental Burden of Waste Oil", "The Environmental Benefit of Recycling Oil" and "Which Oils Qualify for the EcoLogo?"
Price	Free on request
Distributor	Environmental Choice Program

Angular Momentum: The Mechanical Universe Series, 1986

Format	Video (30 min.)
Annotation	An old momentum with a new twist. Kepler's second law of planetary motion, which is rooted here in a much deeper principle, imagined a line from the Sun to a planet that sweeps out equal areas in equal times. Angular momentum is a twist on momentum, the cross product of the radius vector and momentum. A force with twist is torque. When no torque acts on a system, the angular momentum of the system is conserved.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Conservation Laws and Fundamental Forces: The Mechanical Universe Series, 1985

Format	Video (59 min.)
Annotation	Contains four elements: conservation of energy, conservation of momentum, angular momentum, and fundamental forces. Explores the following questions: What does conservation of energy mean? If the Universe follows purely mechanical laws, what keeps it ticking away until the end of time? What do the motions of a spinning ice skater and of an orbiting planet have in common? What are the fundamental forces of nature?
Price	Contact distributor
Distributor	Magic Lantern Communications Ltd.

Conservation of Momentum: The Mechanical Universe Series, 1985

Format	Video (29 min.)
Annotation	If the mechanical Universe is a perpetual clock, what keeps it ticking away until the end of time? Momentum, the product of mass and velocity, is always conserved. Newton's laws embody the concept of conservation of momentum and provide a powerful bases for analyzing collisions, even at the local pool hall.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Earth: A Special Case: Planet Under Pressure Series, 1991

Format	Video (20 min.)
Annotation	The unique ability of Earth to support life is the topic of this first program. The immense diversity of life forms that inhabit the planet, and the critical interdependence of species throughout the biosphere are the themes explored. Beginning with a look at the nightmarish conditions on other planets in the solar system, the program shows how Earth's unique position in space sustains life. Diving deep into the soil, a 3-D animated sequence reveals the immense diversity of life on the planet by examining just a few square metres of soil.
Price	Contact distributor
Distributor	TV Ontario

Force and Motion: Newton's Three Laws, 1982

Format	Video (17 min.)
Annotation	With experiments and laboratory demonstrations, this basic physics film clearly explains Newton's three fundamental laws of force and motion. The velocity of an object remains constant unless a force acts upon it. Force = mass × acceleration. To every action there is an equal and opposite reaction. Newton's laws provide the means by which to predict how any object will behave when a force is exerted upon it. By better understanding these, and other laws of nature, a more thorough knowledge can be gained of oneself as well as the Universe.
Price	Contact distributor
Distributor	Visual Education Centre

Inertia: The Mechanical Universe Series, 1985

Format	Video (29 min.)
Annotation	The rise of Galileo and his fall from grace. Copernicus conjectured that the Earth spins on its axis and orbits around the Sun. Considering its implications, a rather dangerous assumption that prompted rather risky questions: Why do objects fall to Earth rather than hurtle off into space? And in this heretical scheme of things, in which Earth was not at the centre, where was God? Risking more than his favoured status in Rome, Galileo helped to answer such questions with the law of inertia.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Kepler Problem (The): The Mechanical Universe Series, 1985

Format	Video (29 min.)
Annotation	The combination of Newton's law of gravity and F = ma. The task of deducing all three of Kepler's laws from Newton's universal law of gravitation is known as the Kepler problem. Its solution is one of great achievement in western thought.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Kepler's Three Laws: The Mechanical Universe Series, 1985

Format	Video (29 min.)
Annotation	Kepler's three laws described the motion of heavenly bodies with unprecedented accuracy. However, the planets still moved in paths traced by the ancient Greek mathematicians, the conic section called an ellipse.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Kinematics and Scientific Methods: The Mechanical Universe Series, 1985

Format	Video (59 min.)
Annotation	This video contains four elements: the law of falling bodies, inertia, moving in circles, and the Millikan experiment. It explores the following questions: Do heavier bodies fall faster than lighter ones? How can the motion of a falling object appear the same on a moving Earth as on a stationary Earth? How do we describe the circular motion of heavenly bodies? How does science progress?
Price	Contact distributor
Distributor	Magic Lantern Communications Ltd.

Law of Falling Bodies (The): The Mechanical Universe Series, 1985

Format	Video (29 min.)
Annotation	With the conventional wisdom of the Aristotelian world view, almost everyone could see that heavy bodies fell faster than lighter ones. Then along came Galileo. He deduced that the distance a body has fallen at any instant is proportional to the square of the time spent falling. His imaginative experiments proved that all bodies fall with the same constant acceleration.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Microgravity: Space Education Series, 1989

Format	Video (12:25 min.)
Annotation	Gravity and its varying effects are explored, and a spacecraft in orbit is compared with a thrown ball to explain the concept of free fall. Zero gravity is introduced, and the opportunities it presents for society to study are shown in some experiments performed in NASA's KC-13 jet, flown at zero gravity.
Price	Contact distributor
Distributor	TV Ontario

Moving in Circles: The Mechanical Universe Series, 1985

Format	Video (29 min.)
Annotation	The original Platonic ideal, with derivatives of vector functions. According to Plato, stars are heavenly beings that orbit the Earth with uniform perfection, uniform speed and in perfect circles. Even in this imperfect world, uniform circular motion makes perfect mathematical sense.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Newton's Laws: The Mechanical Universe Series, 1985

Format	Video (29 min.)
Annotation	For all the phenomena of the mechanical universe, Isaac Newton laid down the laws. A refinement on Galileo's law of inertia, Newton's first law states that all bodies remain at rest or continue in uniform motion unless an unbalanced force acts on them. His second law, the most profound statement in classical mechanics, relates the causes of motion to the changes in motion in every object in the cosmos. Newton's third law explains the seemingly extraordinary phenomenon of interactions, for every action there is an equal and opposite reaction. The program includes examples of how Newton's laws are applied in real life.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Physics on Earth and in the Heavens: The Mechanical Universe Series, 1985

Format	Video (59 min.)
Annotation	This video contains four elements: Newton's Laws, the Apple and the Moon, Harmonic Motion, and Navigating in Space. It explores four questions: What are the causes of motion? How is the motion of the Moon around the Earth like that of a falling apple? Why do some motions repeat themselves regularly? How do you get from Earth to Venus?
Price	Contact distributor
Distributor	Magic Lantern Communications Ltd.

Vectors: The Mechanical Universe Series, 1985

Format	Video (29 min.)
Annotation	Physics must explain not only why and how much, but also where and which way. Physicists and mathematicians invented a way of describing quantities that have direction as well as magnitude. Laws that deal with such phenomena as distance and speed are universal. And vectors, which describe quantities, such as displacement and velocity, universally express the laws of physics in a way that is the same for all coordinate systems. The program includes examples of how vectors are used in real life.
Price	$99
Distributor	Magic Lantern Communications Ltd.

What If?, 1989

Format	Video (12 min.)
Annotation	Experiments performed in microgravity help viewers understand what would happen if everyday processes, such as convection, sedimentation and surface tension, were unaffected by gravity. This leads to a look at the possibilities for developing new materials in space.
Price	Contact distributor
Distributor	TV Ontario

Other Learning Resources: Science 30

The resources identified below have not been evaluated by Alberta Education. These listings are not to be construed as an explicit or implicit departmental approval for use. They are provided as a service only to assist school authorities to identify resources that contain potentially useful ideas. The responsibility to evaluate these resources prior to selection rests with the user, in accordance with any existing local policy.

Note: Prices of resources were listed as provided by distributors, May 1993. Check with distributor for current rates.

Unit 1: Living Systems Respond to Their Environment

Amish (The): Genetics Series, 1986

Format	Video (25 min.)
Annotation	Are we a product of our parent's genes or our own environment? The Amish of Lancaster County, Pennsylvania, have provided geneticists with a rare opportunity. With an ancestry traceable to the original two hundred settlers, this religious sect lives in a culture that has changed little since their arrival in the United States in the early 18th century. Due to intermarriage, over 80 per cent share the same surnames, and many husbands and wives are second or third cousins. Join specialists in examining the consequences of such inbreeding, including abnormal susceptibility to rare and recessive diseases and the extent to which environmental factors can contribute to the disease characteristics of a population.
Price	$99
Distributor	Coronet Film and Video

Amniocentesis for Prenatal Testing, 1991

Format	Video (12 min.)
Annotation	The suggestion that a couple undergo amniocentesis often carries with it fear and uncertainty. This video clearly explains the procedures, possible risks and results, answers most commonly asked questions, and provides a springboard for discussion. Could be used to inform and educate couples in both individual or group counselling.
Price	$200
Distributor	McIntyre Media Limited

Circulation of the Blood, 1990

Format	Video (24 min.)
Annotation	The human body requires a constant supply of oxygen and nutrients to its billions of cells, and the constant removal of carbon dioxide and water. These tasks are performed by the blood. In this examination of the circulatory system, animation documents the process that keeps human beings alive. The program explains the function of each part of the heart, shows how matter is exchanged in the cells, and illustrates the role of the nervous system in regulating heartbeat.
Price	$49.95
Distributor	Canadian Learning Company

Circulation of the Blood, 1987

Format	Video (14 min.)
Annotation	Through lifelike animated diagrams, this is a study of the systemic and pulmonary circulation of the blood in the human body. It clearly illustrates the structure and functions of the heart, lungs, arteries, veins and capillary network with detailed views of the heart cycle and the oxygen/carbon dioxide exchange in the cells and air sacs of the lungs.
Price	$394
Distributor	Marlin Motion Pictures Ltd.

Genes and Hereditary Disorders, 1989

Format	Video (22 min.)
Annotation	An introduction to the link between genes and diseases, such as cystic fibrosis and Down's syndrome. With the aid of animation, a genetic counsellor describes how chromosomes and genes, dominant and recessive traits, family and ethnic background and environmental influences can affect fetal health. What is amniocentesis? CVS? Ultrasound examination? How can genetic counselling be a part of family planning? These are all questions that are addressed in the video.
Price	$480
Distributor	McIntyre Media Limited

Genetics: Science Show Series, 1990

Format	Video (26 min.)
Annotation	Deep in the heart of every living cell beat thousands of microscopic units called genes. When it was discovered that these seemingly anodyne particles actually served as data banks for cells, geneticists triggered a revolution. This episode unravels the DNA molecule, the long, two-stranded chain that makes up the genes. It shows some of the achievements of genetic engineering, a science which has enabled scientists to create new plant and animal species. It also explores the medical and ethical repercussions of genetics: Could scientists go too far in their quest to produce "supermen"?
Price	$250
Distributor	Le Groupe Multimédia du Canada

Immune System (The): Science Show Series, 1990

Format	Video (26 min.)
Annotation	In our bodies, an army of cells is constantly on the alert. Its mission is to wipe out any foreign cells, viruses or bacteria that would attack their fortress, the human body. This episode uses imagery to describe the battles the immune system wages, showing how it sets up a defence against viral invasion. It explains how, through vaccination, the immune system is controlled to work for the good. Cyclosporine, an antirejection drug, actually works to prevent the immune system from going into action, as in the case of organ transplants.
Price	$250
Distributor	Le Groupe Multimédia du Canada

Life Under Pressure, 1991

Format	Video (26 min.)
Annotation	This program follows the journey of a red blood cell through the circulatory system to demonstrate the efficiency and elegance of design that delivers oxygen and food to all parts of the body and removes wastes before they can do harm. It shows how the veins and arteries are structured to perform their tasks: muscular arteries to transmit the force of the heart beat, veins with valves to insure the blood's return to the heart.
Price	$149 U.S.
Distributor	Films for the Humanities and Sciences

Muscular Dystrophy: Race for the Gene, 1988

Format	Video (50 min.)
Annotation	Expert, Dr. Martin-Bobrow, explains how the site of the gene on the X chromosome has been identified, and how this information is being used to develop probes for the detection of carriers of muscular dystrophy. This documentary captures the first major breakthrough on film—a discovery that has given hope that a cure is in sight.
Price	$450
Distributor	Coronet Film and Video

Nervous System: The Human Body Series, 1988

Format	Video (18 min.)
Annotation	Provides a look inside the human body at the nervous system that moderates the activities of the body's complex processes and links the body to its external environment.
Price	Contact distributor
Distributor	National Geographic Educational Services

Our Immune System: The Human Body Series, 1988

Format	Video (26 min.)
Annotation	Each of us has millions of invisible enemies—viruses, bacteria, parasites; but the body's defences are complex and powerful. This film examines challenges to the immune system and how science is helping.
Price	Contact distributor
Distributor	National Geographic Educational Services

Pandora's Box: The Life Revolution Series, 1989

Format	Video (52 min.)
Annotation	What will we do with the accelerating and terrifying capabilities given to us by opening the biotechnology box? Create the perfect race? Sell our genes for huge profits? Destroy humankind with bioweapons? Or use the new knowledge to preserve our species in a clean, healthy and well-fed world? This final program examines the moral dilemmas raised in the series and finds that biotechnology, like Pandora's Box, is a source of both ills and hope for the future.
Price	$149
Distributor	Magic Lantern Communications Ltd.

Stratagem: Modelling Sustainable Development, 1988

Format	Classroom Kit

Annotation

Sustainable development is a concept in social studies and the new science curricula. *Stratagem* is a new way of presenting difficult concepts. It is a model of sustainable development, using a playing board, playing pieces, background material and a computer program. Players become government ministers of a developing country. They decide how to use the country's food, goods and energy resources in an effort to achieve a prosperous, healthy and environmentally sound economy—sustainable development.

History and Purpose

Stratagem was designed for international development officials. It illustrates the many interconnections among various development issues and the long-term effects of policy options on the economy, the environment and human welfare. *Stratagem* has been used as a training tool in over 30 countries for government officials, corporate managers, international aid officers, development experts and students. It has been adapted for Canadian secondary schools, and Alberta Energy has made it available to Alberta teachers.

How It Works

The simulation begins with the country at a stage of economic and social development similar to much of Latin America today. Each participant is assigned one of five government portfolios: population, energy, goods and services, food and environment, or trade and finance. The government must decide how to allocate the food, goods and energy resources to provide for the people and plan the economic development of the country. They are responsible for the country's finances, including foreign trade and debt, and for the quality of the environment. The government can implement a wide variety of social and economic policies but soon discover that achieving sustainable development is not an easy task. Participants can gain a new understanding of the many factors contributing to current political, economic and environmental issues.

What Is Included?

Each kit contains four game boards with gaming pieces, master copies of handout material, a guide, introductory videotape, and a diskette in either MS–DOS or Macintosh format.

Price

Stratagem can be borrowed, at no cost, after attending a full-day workshop by Alberta Energy OR purchase the kit from Synergistics Consulting Ltd. for $220 plus GST (shipping included).

Distributor

Alberta Energy
Synergistics Consulting Ltd.

Susumu Tonegawa: Keys to the Immune System: Nobel Prize Series, 1990

Format	Video (15 min.)
Annotation	This program, on Susumu Tonegawa, includes an interview with the laureate, a student notebook providing an overview of his life and his research into the genetics of antibody diversity and a teacher resource book. One of the basic theories of biology holds that DNA controls the functions and forms of the organism by providing the blueprints for protein molecules. According to this theory, one gene provides the blueprint for one, and only one, protein molecule. Information about the structure of proteins flows from DNA to the molecule and never the other way around. Some of the molecules produced this way are used to build cells. Others are enzymes, which control the body's chemical processes. The molecules Tonegawa studied are antibodies, components of the immune system that combine with a virus or bacteria and render it harmless.
Price	$69
Distributor	Sunburst Communications Inc.

Transplant Immunology: Women in Science Series, 1990

Format	Video (28 min.)
Annotation	This is a career-oriented video in the area of transplant immunology. It may be useful for introducing science–technology–society connections. Patricia Bakkestad-Legare is a medical technologist who does the tissue typing that confirms or disproves the compatibility of donor and recipient tissue. She employs the latest technology, applied to ever-changing and evolving techniques for immunological matching and control. Hers is a 24-hour, 7 days a week position that could result in 20- to 36-hour days, if a donor and recipient are suddenly, as in the case of an accident brought together. Time away in the form of saved vacation days, and a sense of purpose are essential to enjoying and enduring the pressure of this career. Dr. Rachel McKenna is Patricia's supervisor, and the pressures she feels in running the lab are different. She must continuously foster the evolution of the lab, divorcing herself from the practical hands-on in deference to the administrative demands of finding the funding to support the lab's endeavours. Rachel came from a scientific family, and had a father and brother who encouraged and assisted her in pursuing her career aspirations.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Acid Rain: The Invisible Threat, 1992

Format	Video (20 min.)
Annotation	Understand the processes that lead to and create the ecologic damage brought on by acid rain. Interviews, on-location footage and computer animation clearly explain how acid rain affects forests, lakes and the human environment.
Price	$99
Distributor	McIntyre Media Limited

Amazing Vanishing Ozone (The): Icewalk Series, 1989

Format	Video (22 min.)
Annotation	The roof of the Earth is rupturing a hole in its protective skin, the ozone. The Icewalk team experiences the effects firsthand with swollen, burned, peeling skin adding to the tortuous ice conditions throughout weeks of exhaustion. Interviews with scientists suggest that if global warming continues at its present rate, by the year 2050 sea levels will have risen at least 5 metres, and lower-lying island countries will completely disappear. Viewers learn that the depletion of the ozone is caused by airborne pollutants, such as the simple escape of chlorofluorocarbons found in domestic gases and aerosols. In the Arctic, pollutants prevent the escape of reflected heat from the Sun, raising the Earth's temperature and melting the ice.
Price	Contact distributor
Distributor	Visual Education Centre

Alternatives to Pesticides

Format	Print (factsheet)
Annotation	This factsheet discusses alternative methods of pest control for trees and shrubs, lawns and vegetable gardens. It also offers suggestions for companion planting.
Price	Free on request
Distributor	Environment Canada

Assault on the Ozone Layer: The Fragile Planet Series, 1990

Format	Video (18 min.)
Annotation	Industrial smog over the ice fields of Alaska. A growing hole in the ozone layer over Antarctica. Chlorofluorocarbons released in Japan spreading across the Pacific in two weeks, across the entire Northern Hemisphere in four, below the Equator in six, to the South Pole in ten. Destruction of the ozone layer affects the entire globe, regardless of who is doing it, where or why. This program shows how the ozone layer is depleted and how its depletion is stunting, mutating and destroying life.
Price	$139 U.S.
Distributor	Films for the Humanities and Sciences

Black Tide, 1990

Format	Video (50 min.)
Annotation	Prince William Sound, Alaska, USA. In the months following the Exxon Valdez spill of 11 million gallons of toxic crude oil into the Sound, there were several frantic clean-up operations. But the combined efforts of humans and the elements have done little to disperse the black mass that clings to the shore and clogs the life-giving waters. *Black Tide* revisits the chaos of the Valdez clean-up and examines the long term biological impact of America's biggest oil spill. Reports gauge the damage to the area ecosystem and fishing industry, and interviews with oil company executives, lawyers, government officials and locals help to sort out the tangled accusations of how this could have happened. Coverage from Japan, the Middle East, Northern Europe and rare historical archival material bring into focus the world's insatiable thirst for oil, and the disastrous price exacted from the environment. Why do spills occur, and how can we justify so high a cost? This video seeks the answers.
Price	$450
Distributor	T. H. A. Media Distributors

Breath of Fresh Air (A): The Global Environment Series, 1991

Format	Video (20 min.)
Annotation	Clean air is essential to all life, yet one fifth of the world's population breathe air that is hazardous. Fifty per cent of air pollution is caused by cars and trucks burning fossil fuels. Industry also accounts for a large part. In Mexico City, geographical misfortune worsens the situation by trapping bad air. Intense sunlight then transforms the chemical-laden air into ozone, which harms the lungs and pollutes the atmosphere. When it rains, acids take their toll on plants, animals and structures. To combat the destruction, cleaner fuels, emission controls, and energy use reduction are needed.
Price	$99
Distributor	Coronet Film and Video

ChemCom: Chemistry in the Community, 1988

Format	Print Teacher's Guide	ISBN 0840344236 ISBN 0840344244

Annotation

The three objectives of this text are to:

- illustrate the role chemistry plays in our personal and professional lives
- understand how chemistry is used in science/technology, and to solve current issues
- develop an awareness of the potential and limitations of science and technology.

Price	Contact distributor
Author	American Chemical Society
Distributor	Kendall/Hunt Publishers Company

Chemical Survey and Solutions and Pollution, 1990

Format	Print and Kit	ISBN 0201284200
Annotation	This is an activity-based instruction module integrating chemical and Earth sciences concepts and processes with societal issues. It's an inquiry-based, problem-solving approach to learning that emphasizes evidence-based decision making with a focus on chemical pollution. The kit includes a teacher manual, plus all the equipment and supplies needed to conduct the activities outlined in the print material.	
Price	\$25.12 Print \$233.18 Kit	
Author	Chemical Education for Public Understanding Program	
Distributor	Addison-Wesley Publishers Limited	

Clean Air: Industry, Transportation and Air Pollution: Earthbeat Series, 1991

Format	Video (30 min.)
Annotation	This program investigates the alarming pollution statistics in Mexico City. Other communities throughout the United States are then visited to uncover possible solutions to the air problem. The use of a solar powered car is demonstrated. The program closes with a look at tips for energy and air conservation. Teacher's guide included.
Price	\$149
Distributor	New Vision Media

Crisis in the Atmosphere: Understanding Global Climate Changes: Infinite Voyage Series, 1991

Format	Video (60 min.)
Annotation	The severity and potential harm of global warming, the ozone hole and air pollution are explored through an adventure to the Arctic, interviews with prominent scientists and a visit to the National Centre for Atmospheric Research. Viewers learn what has happened to the environment and why. Study guide included.
Price	$249
Distributor	New Vision Media

Determining Threshold Limits, 1990

Format	Print and Kit	ISBN 0201284189
Annotation	This is an activity-based instruction module integrating chemical and Earth sciences concepts and processes with societal issues. An inquiry-based, problem-solving approach to learning that emphasizes evidence-based decision making with a focus on risk/benefit analysis. The kit includes a teacher manual, plus all the equipment and supplies needed to conduct the activities outlined in the print material.	
Price	$25.12 Print $202.59 Kit	
Author	Chemical Education for Public Understanding Program	
Distributor	Addison-Wesley Publishers Limited	

Down in the Dumps: The Global Environment Series, 1991

Format	Video (20 min.)
Annotation	Garbage: the human race produces it at an alarming rate, especially in the developed countries where everything comes packaged. Chemical reactions within garbage piles send their toxins into the Earth, and into the water supply. However, recycling is starting to take hold. Today, wealthy nations are increasingly collecting, cleaning, melting down and making multiuse of glass, metal and plastic. *Down in the Dumps* shows what's happening to the world's trash and the problems yet to be overcome, if we are not to be overwhelmed by our own debris.
Price	$99
Distributor	Coronet Film and Video

Environment: Science Show Series, 1990

Format	Video (26 min.)
Annotation	Our planet's SOS cries are becoming increasingly alarming. All forms of pollution are stripping and stifling our planet. This film looks into the global situation and provides keys to better understanding of such phenomena as polychlorinated biphenyls (PCBs) and acid rain. Through graphics, the viewer is able to visualize the repercussions of the greenhouse effect and the depletion of the ozone layer.
Price	$150
Distributor	Le Groupe Multimédia du Canada

Fit to Drink, 1989

Format	Video (20 min.)
Annotation	This program traces the water cycle, beginning with the collection of rainwater in rivers and lakes through a water treatment plant, to some of the places where water is used, and finally back into the atmosphere.
Price	$149 U.S.
Distributor	Films for the Humanities and Sciences

Fossil Fuels, 1991

[also see Science 30, Unit 4]

Format	Video (19 min.)
Annotation	This videotape explains the origin, uses, and environmental impacts of coal, oil and natural gas. Live action footage, interviews and graphics are used to show how Earth's non-renewable energy resources are formed. Computer maps and graphs locate these resources and help to explain why rapid depletion of non-renewable fossil fuels is creating political, economic and environmental crises the world over. Geologically, the processes that create fossil fuels take millions of years in a natural process known as the carbon cycle. Historically, however, the extraction and burning of these fossil fuels is only 200 years old. Today, because of soaring populations, coupled with increasing demands for transportation fuels and electric power, fossil fuels have become the world's most widely used energy resource. Experts wonder how long this can last. Not only are we faced with finite quantities of all fossil fuels, but our burning of these materials is becoming a potentially destructive force. Acid rain, air pollution, and even the risk of greenhouse warming, threaten Earth's biosphere, atmosphere and hydrosphere. To meet this challenge, ways must be found to conserve existing fossil fuels while advancing alternative energy sources. Renewable energies, such as solar power, may hold the promise of the future—long after the age of fossil fuels has past.
Price	$64.95 U.S.
Distributor	Scott Resources Inc.

Great Lakes: Troubled Water (Update): The Nature of Things Series, 1986

Format	Video (55 min.)
Annotation	This video looks at the abuse of one of the world's natural wonders—the Great Lakes—focusing on the Niagara Falls drainage basin, a "toxic time bomb" and repository of more than 250 chemical dump sites. Technologies to detect contaminants in the system are described and viewers learn why the ideal solution to this dire situation may be unreachable.
Price	1/2" - $109; 3/4" - $160
Distributor	CBC Educational Sales

Hazardous Waste Management: Alberta's Success Story, 1988

Format	Video (12 min.)
Annotation	This program outlines the procedures used to manage hazardous waste in Alberta's Swan Hills Treatment Plant.
Price	Free on request
Distributor	Alberta Special Waste Management Corporation

Household Hazardous Waste Management, 1988

Format	Video (11 min.)
Annotation	This clip identifies four categories of hazardous household products and shows what happens when they are disposed of improperly. It discusses a number of important issues, such as waste management, community health, consumer responsibility and environmental protection.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC310101

Howe Sound: Poisoned Waters: The Nature of Things Series, 1989

Format	Video (47 min.)
Annotation	Toxic discharge from two pulp mills closed shellfish harvesting in Howe Sound, north of Vancouver. The two mills broke British Columbia's pollution laws for years. Local environmental groups say the provincial government did not enforce compliance. This is a look at the pollution caused by pulp mills and the bitter fight surrounding the operation of the two mills in Howe Sound.
Price	1/2"–$109; 3/4"–$160
Distributor	CBC Educational Sales

Into Deep Water: Turning the Tide Series, 1988

[see annotation Science 20, Unit 2]

Investigating Groundwater: The Fruitvale Story, 1991

Format	Print and Kit	ISBN 020128426X
Annotation	This is an activity-based instruction module integrating chemical and Earth sciences concepts and processes with societal issues. It's an inquiry-based, problem-solving approach to learning that emphasizes evidence-based decision making with a focus on water pollution. The kit includes a teacher manual, plus all the equipment and supplies needed to conduct the activities outlined in the print material.	
Price	$25.12 Print $202.12 Kit	
Author	Chemical Education for Public Understanding Program	
Distributor	Addison-Wesley Publishers Limited	

New Alchemy (The): W5 Series, 1992

Format	Video (9 min.)
Annotation	Dr. John Todd has built a greenhouse that harbours something called a "living machine". Into it pours sewage and out of it; plants, bacteria, fish and snails all thrive in a process that purifies water.
Price	$135
Distributor	CTV Program Sales

Only One Atmosphere: Race to Save the Planet Series, 1991

Format	Video (60 min.)
Annotation	This film examines the possible global warming of the Earth's atmosphere and suggests that it may be the greatest environmental challenge the world has ever faced.
Price	$149
Distributor	Magic Lantern Communications Ltd.

Ozone and UV Bulletins, 1993

Format	Print
Annotation	A series of thirteen comprehensive ozone and ultraviolet bulletins developed by Environment Canada. These one-page bulletins could be incorporated into daily lesson plans.
Price	Free on request
Distributor	Environment Canada

Ozone Blanket in the Air: Science Screen Report Series, 1991

Format	Video (15 min.)
Annotation	It's triatomic, allotrophic and the only barrier between humankind and the Sun's harmful ultraviolet light. This program looks at the importance and future of ozone—the Earth's blanket in the air.
Price	$99
Distributor	Magic Lantern Communications Ltd.

PCBs in the Food Chain, 1990

Format	Video (18 min.)
Annotation	Shown are the effects of marine pollution moving up through the food chain, as the tiniest plankton absorb poisons and pass them up the chain, poisoning those who feed upon them. Thus, dolphin blubber shows traces of polychlorinated biphenyls (PCBs) in concentrations 100 000 times greater than the seas in which the dolphins lived, because the toxins are long-lived and accumulate in body tissue.
Price	$139 U.S.
Distributor	Films for the Humanities and Sciences

Proton in Chemistry (The): The World of Chemistry Series, 1990

Format	Video (28 min.)
Annotation	This film focuses on acids, bases and pH; how they function in the laboratory and in natural systems.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Royal Flush: W5 Series, 1991

Format	Video (11 min.)
Annotation	Victoria, British Columbia dumps raw sewage into border waters and the Americans are upset. Many environmentalists and politicians on both sides of the border would like to see sewage treatment plants built, but many scientists say sewage discharge is, in fact, good for the ocean.
Price	$135
Distributor	CTV Program Sales

Storm of Acid Snow (The): Icewalk Series, 1989

Format	Video (22 min.)
Annotation	Battling frostbite and an ocean of fractured ice, the student expedition documents a dramatic buildup of global pollution. Leading environmentalists and Arctic experts discuss the effects of airborne pollutants and suggest that the pollution in the Arctic may cause the polar ice cap to melt, which would then elevate sea levels, causing flooding worldwide. Viewers learn that the global environment is an integrated system. Gases, such as sulfur dioxide and nitrogen oxides, produced by worldwide industrial centres, are carried to the polar regions by air currents and then deposited on the ground through precipitation in the form of acid rain or acid snow.
Price	Contact distributor
Distributor	Visual Education Centre

Toxic Waste: A Teaching Simulation, 1991

Format	Print and Kit ISBN 0201284227
Annotation	This is an activity-based instruction module integrating chemical and Earth sciences concepts and processes with societal issues. It's an inquiry-based, problem-solving approach to learning that emphasizes evidence-based decision making with a focus on the problems created by toxic wastes. The kit includes a teacher manual, plus all the equipment and supplies needed to conduct the activities outlined in the print material.
Price	$23.24 Print $261.47 Kit
Author	Chemical Education for Public Understanding Program
Distributor	Addison-Wesley Publishers Limited

Valley of Heart's Delight: Only One Earth Series, 1987

Format	Video (30 min.)
Annotation	Residents of Silicon Valley are working to eliminate the water pollution and consequent birth defects the "clean" computer chip industry brought with it.
Price	Contact distributor
Distributor	Visual Education Centre

What's on Tap?: The Global Environment Series, 1991

Format	Video (20 min.)
Annotation	There is increasing trouble with the world's water supply—deadly trouble. In Third World countries, 10 000 children die each day from diarrhea often caused by water-borne parasites and bacteria. Even in industrialized nations, water is often in jeopardy. Purification requires a careful juggling act that can affect wildlife. Certain chemicals in the water can mean cancer to animals and people and the disappearance of traditional ways of life. Natural reservoirs are being tapped and possibly tapped out. What, if anything, will spill from the spigot is increasingly in question.
Price	$99
Distributor	Coronet Film and Video

Communicating at the Speed of Light, 1988

Format	Video (53 min.)
Annotation	This program, placed within the context of the telephone system, is a fast-paced documentary that examines the new technology of fibre optics. Also covered are other uses for fibre optics, as well as some of those planned for the future.
Price	$149
Distributor	Magic Lantern Communications Ltd.

Electromagnetism (Part 1: Electric Fields, EM Fields, Motor Effect), 1993

Format	Video (29 min.)
Annotation	This film shows how harnessing the principles of electromagnetism is central to our modern way of life. It examines historical experiments, explains concepts, and illustrates their application in a wide range of inventions.
Price	$69
Distributor	Classroom Video

Energy Control and Communication: Pathways Through Science Series, 1992

Format	Print ISBN 0582094119
Annotation	This module contains teaching strategies and 62 activities dealing with sound vibrations, sound signals and electronic control. Examples of some of the investigations are how sound travels, magnetic field investigations, building a door alarm and synthesizers. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science–technology–society connections related to sound and electron control systems. A study guide outlines main ideas for review. Some of the examples used have a British context.
Price	$69.56
Distributor	Copp Clark Pitman Ltd.

Lake That Fell to Earth (The), 1992 [also for Science 30, Unit 4]

Format	Video (53 min.)
Annotation	In the tundra region beyond the 49th parallel, a curious phenomenon can be witnessed. A lake—unlike any other—a perfect circle 2.7 kilometres in diameter, 267 metres deep, with 35 metres of pure and transparent visibility. The Inuit of the region call this enigmatic landmark "Pingualuit", or big hill, referring to the mound that surrounds it. For scientists, it is a lake from outer space—a meteorite that collided with the Earth and offers a treasure chest of clues to the Earth's history and to cosmic occurrences.
Price	$200
Distributor	Le Groupe Multimédia du Canada

Lasers: The Science of Light Amplification: Science Screen Report Series, 1991

Format	Video (12 min.)
Annotation	Since their invention in the 1960s, science has found many uses for lasers. They help speed shoppers through check-out lines, are used in precise medical procedures, and are an essential element in modern industrial processes. Discover what makes a laser beam, the many different types of lasers, the precautions of working with lasers and their important role in today's society. From the frontiers of laser research to the development of the mid-infrared, advanced chemical and high energy laser . . . the latest in high technology.
Price	$99
Distributor	Magic Lantern Communications Ltd.

Light and the Electromagnetic System: Physical Science II Series, 1986

Format	Video (14 min.)
Annotation	The relationship between light and other forms of electromagnetic radiation—cosmic rays, gamma rays, X-rays, ultraviolet and infrared rays, radio waves and light waves—is demonstrated during a television station broadcast of a videotape of jazz dancers. Other videotapes broadcast at the station help viewers understand how the generation and transmission of these waves has allowed scientists to probe the hidden regions of the human body and to explore the mysteries of the Universe.
Price	$415
Distributor	Coronet Film and Video

Light, Color and the Visible Spectrum: Physical Science Series, 1986

Format	Video (14 min.)
Annotation	A colourfully costumed jazz group is videotaped. As viewers observe the effects of using and mixing coloured lights and filters, the principles of additive and subtractive colour mixing are illuminated. Straight forward demonstrations show that all the colours we see depend on which of the wavelengths of white light reach our eyes.
Price	$415
Distributor	Coronet Film and Video

Radar: Vision from Space: The Nature of Things Series, 1987

Format	Video (30 min.)
Annotation	Since its development in England in the 1930s, radar has been used for a multitude of purposes, from intercepting enemy aircraft during the Second World War to making high-resolution images of areas, such as the Sahara Desert and the Amazon rainforests. This program explains how such developments have heightened scientists' knowledge of climate patterns, geology and the environment. Now technologies, such as stereomapping, produce three-dimensional radar images, which provide views of the entire globe.
Price	1/2" - $109; 3/4" - $160
Distributor	CBC Educational Sales

Recording and Reproduction Techniques: The Science Show Series, 1990

Format	Video (26 min.)
Annotation	In this era of communications, the technologies used to record and reproduce sounds and images are becoming highly diversified and perfected. This episode introduces three of these techniques: computer graphics, or computer assisted animation; laser discs, capable of storing vast quantities of sound data without altering its quality; and holography, also based on the laser beam, which captures images of objects in three dimensions.
Price	$250
Distributor	Le Groupe Multimédia du Canada

Anatomy of an Oil Spill, 1990 [see annotation Science 20, Unit 2]

Conservation Pamphlets:

- How to Find Planet-friendly Products
- Our Future: A Secure Environment
- World Conservation Strategy
- Saving the Environment

Annotation	Pamphlets outlining information on sustainable development and global initiatives taken for the conservation of resources.
Price	Free on request
Distributor	Environment Canada

Conserve Energy: Alternative Solutions: Earthbeat Series, 1991

Format	Video (30 min.)
Annotation	The energy fitness teams from Massachusetts show how simple home adjustments can deliver cash back on utility bills. This team introduces companies that are urging customers to participate in conservation. A trip to Africa shows one man building special ovens that use less wood to produce more heat. The program concludes with a southern California power company harnessing the energy of the Sun.
Price	$149
Distributor	New Vision Media

Energy Resources: Pathways Through Science Series, 1992

Format	Print	ISBN 0582094038
Annotation	This module contains teaching strategies and 62 activities dealing with energy resources. Examples of some of the investigations are energy issues and solutions, energy for heating, heating the home and energy efficiency. A commentary is cross-referenced to the activities and provides background information and sample results of experiments. A source book contains science-technology-society connections related to the global use of energy resources. A study guide outlines main ideas for review. Some of the examples used have a British context.	
Price	$69.56	
Distributor	Copp Clark Pitman Ltd.	

Energy for Societies: You, Me and Technology Series, 1986

Format	Video (20 min.)
Annotation	A young woman, concerned about the shrinking supply of oil and gas, investigates the advantages and disadvantages of coal, nuclear fission, trombe walls and photovoltaics, windmills, biomass, conservation and cogeneration systems.
Price	$320
Distributor	Kinetic Inc.

Energy: What About Tomorrow?, 1987

Format	Video (20 min.)
Annotation	Shortage of oil and natural gas, the rising cost of energy resources and world population growth have combined to stimulate an intensive search for alternate energy sources. Solar energy is a possibility, geothermal resources are seen as a great boon to nations poor in fossil fuel, and sophisticated fusion research is going on in laboratories around the world. No one source will be sufficient to meet all our future needs, so every possibility must be explored.
Price	Contact distributor
Distributor	Visual Education Centre

Fossil Fuels, 1991

[see annotation Science 30, Unit 2]

Geothermal Energy: The Earth Explored Series, 1983

Format	Video (28 min.)
Annotation	The Earth's interior provides a great deal of heat which possibly can be captured for humankind's use. The program explains the dynamics involved in using geothermal resources, explores the prerequisite structure below the Earth's surface that allows geothermal sources to be tapped, examines methods for translating geothermal reserves into usable energy, and visits locations where the process is being used.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network VC279807

Guideposts for a Sustainable Future, 1990

Format	Video (23 min.) Print	 ISBN 0969422806
Annotation	Environmental security depends on our ability to imagine a sustainable future. Historically, we have never felt called upon to imagine the global implications of our actions. Now we are compelled to do so as our future is being determined by our ability to bear the global picture in mind and act from the concerns presented by that picture. The video and book in this kit provide images, ideas and information about the relationship between humanity and the Earth. It is designed to help the viewer visualize a way to live that can be sustained.	
Price	$100 per kit (video and print) Bulk: $50 each for bulk purchase of 50 kits	
Distributor	Education Through Video Ltd.	

Lake That Fell to Earth (The), 1992 [see annotation Science 30, Unit 3]

Light and Energy: Science Show Series, 1989

Format	Video
Annotation	What is the principle source of energy on this planet? Would you believe . . . photosynthesis! As a matter of fact, by using this chemical reaction, plants capture the light of the Sun and transform it into energy-rich chemical compounds. On this planet, the energy stored by plants every year represents ten times humankind's food consumption and corresponds to two hundred times their food requirements! It is no wonder that researchers are trying to harness the energy stored by plants. This program describes such attempts, as well as sophisticated techniques enabling researchers to measure plant photosynthesis. In closing, the host describes the current state of solar energy research. Several different methods, such as simple solar captors or photovoltaic cells, are already available to capture the Sun's energy and convert it to a usable form.
Price	$250
Distributor	Le Groupe Multimédia du Canada

Light Makes Electricity, 1990

Format	Video (12 min.)
Annotation	Since the discovery, 100 years ago, that light could be converted into electricity, scientists and researchers have attempted to explore the benefits that could be derived from using solar energy in a number of new ways, from heating homes to powering appliances. This program describes the production and function of solar cells, illustrating how they convert sunlight into electric current. The video also explains that despite solar energy's great potential, many obstacles must be overcome before it can be accepted as an efficient and practical means of generating the amount of electricity needed by the modern world.
Price	$500
Distributor	Marlin Motion Pictures Ltd.

Nuclear Energy, 1990

Format	Video (22 min.)
Annotation	Just the term "nuclear energy" makes us shudder. And yet, though it sometimes escapes humankind's control, nuclear energy is a source of benefits, and could even, someday, satisfy most of our energy needs. This film takes us into the heart of the atom, to examine the processes of fission and fusion, by which energy can be produced using uranium or even water. The viewer learns that nuclear energy is also used to save lives, through radiation therapy, and through a process called food irradiation, can help prolong the length of time that foods can be preserved and prevents the buildup of bacteria and molds.
Price	$250
Distributor	Le Groupe Multimédia du Canada

Nuclear Power: Fission, Fusion and Their Applications, 1992

Format	Video (31 min.)
Annotation	This program looks at the practical applications of nuclear energy and includes footage from nuclear power stations and fusion laboratories.
Price	$69
Distributor	Classroom Video

Nuclear Waste Management: Science Screen Report Series [see annotation Science 20, Unit 2]

Power for the People: The Global Environment, 1991

Format	Video (20 min.)
Annotation	Sooner or later, fuels the world has become dependent upon are going to run out. But along the way, gas, oil, coal and wood will keep polluting the environment. Nuclear power was once thought to be a saviour, until it proved costly and dangerous. Other avenues are being explored—wind and Sun sources; wave power; and power from waste in the forms of methane gas and wood chips. As the efficient use of power becomes ever more important, witness high speed trains, better insulation and construction design, and smarter behaviours.
Price	$99
Distributor	Coronet Film and Video

Primal Furnace: Geothermal Energy, 1990

Format	Video (22 min.)
Annotation	This video covers the history of geothermal energy, defining the different types available and where it is available throughout the world. It includes a comprehensive overview of the potential and limitations of this energy source.
Price	$49.95
Distributor	Canadian Learning Company

Pulp Mills, 1989

Format	Video (29 min.)
Annotation	People in the Northwest Territories fear a proposal by southern and foreign companies to build a series of pulp mills.
Price	See ACCESS Network catalogue
Distributor	ACCESS Network

Running Out of Steam: Turning the Tide Series, 1988

Format	Video (26 min.)
Annotation	David Bellamy tackles the global energy crisis, and asks who really benefits from present policies. He argues that instead of building more power plants, we should concentrate on using energy more efficiently. This, combined with a serious commitment to renewable energy sources, would create more jobs and warmer homes.
Price	$350
Distributor	McNabb and Connolly Films

ADDRESSES

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